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The Effect of Temperature on the

Moisture Regain of Wool

By A. C. GOODINGS†

Temperature, as well as relative humidity, is known to influence the moisture regain of wool. The magnitude of this temperature effect for temperatures within the atmospheric range has been measured at relative humidities ranging from dryness to saturation.

INTRODUCTION

THE industrial importance, as well as the scientific interest, associated with the moisture relations of the various textile fibers has resulted in considerable investigational work having been carried out on this subject. Determinations of the moisture absorbing capacity of wool were first made by Schloesing[1] and Hartshorne[2], and more recently, among others, by Shorter and Hall[3], Hedges[4], and Speakman[5]. In the earlier work it was shown that the amount of moisture absorbed by wool was chiefly dependent upon the relative humidity of the atmosphere in equilibrium with it, and to a lesser extent upon temperature. At that time, however, no account was taken of the hysteresis effect associated with wool-moisture relations which arises out of the conditions of sorption; and it is interesting to note that Hartshorne overcame the experimental difficulty of what he describes as a time "lag" by "weighing two skeins which were one drier and the other more moist than the local conditions would probably give", and taking the mean. In the later work of Hedges[4] on moisture absorption by wool at temperatures of 17°C. and 29°C. the sorption conditions again do not appear to have been given recognition. The more accurate work of Speakman[5] on the moisture absorbing capacity of different wools, which takes account of the hysteresis effect, was all carried out at the one temperature of 25°C.

In studying the absorption of moisture by wool with particular reference to atmospheric conditions, it was necessary to obtain quantitative information on the effect of temperature on the amount of water absorbed under known sorption conditions. Two temperatures suited to give this information were chosen at 10° C. and 30° C. (50° Fahr. and 86° Fahr.); and the regain of wool was determined under absorption and desorption conditions at these two temperatures for relative humidities ranging from dryness to saturation.

EXPERIMENTAL

Material and Method of Purification

The wool used in the main experiments was a 64's Australian merino obtained in the grease. A mild scour to remove extraneous dirt and foreign material was followed by alcohol extraction, ether extraction, and a further alcohol extraction. The wool was then washed and allowed to soak overnight in distilled water to remove all alcohol and finally dried at room temperature. Additional experiments quoted were carried out on a 70's merino wool obtained in the form of top and which has been given the usual mill processing procedure up to that stage. The cleansing of the wool top was carried out in the same manner as with the raw wool, no heat treatment being given in the drying.

Experimental Method

The regain measurements were made on small samples of wool (approximately 0.1 gm.) using a sensitive quartz spiral balance of the McBain-Bakr type having an extension of approximately 0.4 mm. per mg., the spiral length being observed by means of a cathetometer reading

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[1] Schloesing. Bull. Soc. d'Encour., 1893. *Textile World Record*, 1908.

[2] Hartshorne, *Trans. New England Cotton Mfrs. Ass.*, 1911.

[3] Shorter and Hall, *J. Text. Inst.*, 1924, *15*, T305.

[4] Hedges, J. J. *Trans. Farad. Soc.*, 1926, *22*, 178.

[5] Speakman, J. B. *J. Soc. Chem. Ind.*, 1930, *49*, 209.

to 0.01 mm. The spiral and wool was enclosed in a glass vessel, the bottom of which consisted of a cup with ground glass joint which could be interchanged with a similar cup as required. The desired humidity was obtained using aqueous solutions of sulfuric acid, the relative humidity being calculated from the strength of acid employing the vapor pressure data of Wilson[8]. The acid solution to be used was placed in the cup at the bottom of the apparatus and changes from one humidity to another were effected by changing cups, the whole operation taking a matter of only a few seconds. The temperature was controlled by immersion of the apparatus into a water bath controlled to within 0.02° C. In cases where the short time in which the apparatus was removed from the thermostat might introduce an error by change of the sorbing state, as, for example, in changing from one high relative humidity to another not very different from the former, additional precautionary measures were observed. In such cases, where absorption values were being obtained, the apparatus was quickly removed from the bath, the acid cup replaced by one containing phosphorus pentoxide, and the wool dried out completely or to a low moisture content before going on to a determination at a higher humidity. By this means the chance of getting irregularly high values arising from a desorbing state was obviated. A similar procedure using water in place of phosphorus pentoxide was adopted where necessary in obtaining desorption values. Values very close to saturation on the desorption curve were not attempted, the highest relative humidity employed being 97.6%. Experiments were carried out at 30° C. and 10° C., the same sample of wool being employed for both temperatures. The dry weight of the wool sample was obtained by drying over phosphorus pentoxide at 30° C. until no further loss in weight was detectable over a period of one week.

Following the dry weight determination, regain values were then obtained on an absorption curve at 30° C., increasing the relative humidity progressively up to saturation. The value at each humidity was taken as representing equilibrium when no further measurable increase in weight was observed over a period of at least 24 hours. An attempt was made to obtain a value at saturation by placing water in the bottom of the apparatus instead of aqueous sulfuric acid, but it was found impossible to obtain a figure on which any reliance could be placed. As the wool requires some considerable time to absorb the moisture required for it to be in equilibrium with a saturated atmosphere, it is impossible, no matter how small the temperature fluctuation of the thermostat, to avoid condensation of moisture in the absorption tube. Such condensation taking place on the wool tends to build up continuously, and it is impossible to say whether any such condensation did not take place before the wool had reached an equilibrium moisture content. In one experiment carried out, no noticeable filming on the glass of the apparatus took place until after the weight of wool had approached reasonable constancy. This result is quoted below for the interest attachable to the figure obtained and not as any accurate regain value.

In view of the fact that any value obtained at saturation is to be regarded with suspicion, it was considered advisable to obtain several points on the regain curve at high humidities approaching saturation. Relative humidities up to a value where the maximum temperature fluctuation of the thermostat could not quite produce a saturated atmosphere were employed. Possibility of condensation was thus obviated; and the regain values found are recorded as corresponding to the relative humidities calculated from the partial pressure of the aqueous sulfuric acid solution at the mean temperature of the thermostat.

Before beginning to determine desorption regain values employing progressively lower humidities, the wool was placed over water in the apparatus for a considerable period in order to assure complete saturation of the wool.

RESULTS

The results obtained for two samples of wool are given following. Sample A was received as wool in the grease, Sample B in the form of top, both extracted as stated. The moisture absorbed at any relative humidity is recorded as regain (parts of moisture per 100 parts of dry wool).

TABLE I

SAMPLE A. 64's Merino Wool. Unprocessed

Regain at 30°C.			*Regain at 10°C.*		
Rel. Humidity (%)	*Absorption*	*Desorption*	*Rel. Humidity (%)*	*Absorption*	*Desorption*
4.7	2.33	3.09	1.7	.....	2.74
12.4	4.39	5.62	3.7	.....	3.98
25.5	6.72	.....	10.5	5.08	6.51
39.5	8.92	10.42	36.8	10.56	12.41
53.9	11.66	.....	68.2	16.50	19.20
69.9	14.95	16.32	91.0	25.32	27.16
80.4	17.70	.....	97.4	30.86	32.78
91.5	23.05	24.35	99.7	36.16	
97.6	30.17	31.80	100	38.68	
99.0	33.33	.....			
99.7	35.39	.....			

TABLE II

SAMPLE B. 70's Merino Wool. Top

Regain at 30°C.			*Regain at 10°C.*	
Rel. Humidity (%)	*Absorption*	*Desorption*	*Rel. Humidity (%)*	*Absorption*
24.2	6.48	.....	34.3	10.82
37.1	8.91	10.53	68.0	17.43
52.7	11.74	.....		
69.6	15.00	16.78		
80.3	18.01	.....		
91.4	23.50	24.84		
97.6	30.21	31.62		
99.0	32.63	.....		
99.6	34.20	.....		
99.9	35.87	.....		
100.0	37.5	.....		

The more complete results for Sample A given in Table I are shown graphically in Fig. 1.

In view of the unexpectedly high values for regain obtained at high relative humidities in the case of Sample A, a larger number of experimental determinations were

[8] Wilson, R. E. *Ind. and Eng. Chem.*, 1921, *13*, 326.

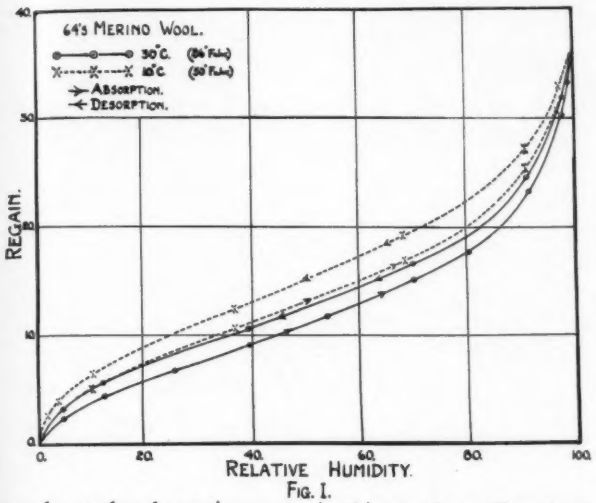

FIG. I.

made on the absorption curve in this regain on Sample B in order to obtain more definite information regarding the slope of the curve near saturation. The absorption curve at 30° C. for this high relative humidity region is shown on larger scale in Fig. 2.

DISCUSSION

General Form of the Regain Curves

The results obtained for the two samples are in general form the same, and show only such small differences as to be expected from samples taken from different sources. The chief difference obtained in general form of the wool regain curve, from what appears to have been previously accepted, lies in the shape of the curve at high relative humidities. A saturation value for wool of around 33% regain is generally quoted. Little investigational work on wool in the region of high relative humidities is to be found in the literature, and most of the evidence for stated regain values at 100% R.H. has been obtained from determinations attempted by exposure of wool over bulk water in a closed vessel. Owing to the experimental difficulties attendant upon such a method, particularly in view of the large falling off in the rapidity of the absorption at high humidities, such determinations would appear to be open to objection. In the present work, as stated in the experimental part of this paper, it was not found possible to obtain a figure for regain in saturated air on which it was felt any reliance could be placed. The slope of the regain-humidity curve, however, shows that much higher value than 33% exist in the wools examined, the curve rising very steeply near saturation. Owing to this steepness in the slope, extrapolation to 100% relative humidity would be a doubtful and inaccurate procedure and for this reason no attempt has been made to do so.

The slope of the desorption curve near saturation is indefinite, no value for regain under desorption conditions having been obtained at humidities higher than 97.6% of saturation. From the shape of the absorption and desorption curves, however, it can be said that it would appear they could not meet, unless some abrupt change takes place, under a regain considerably higher than any

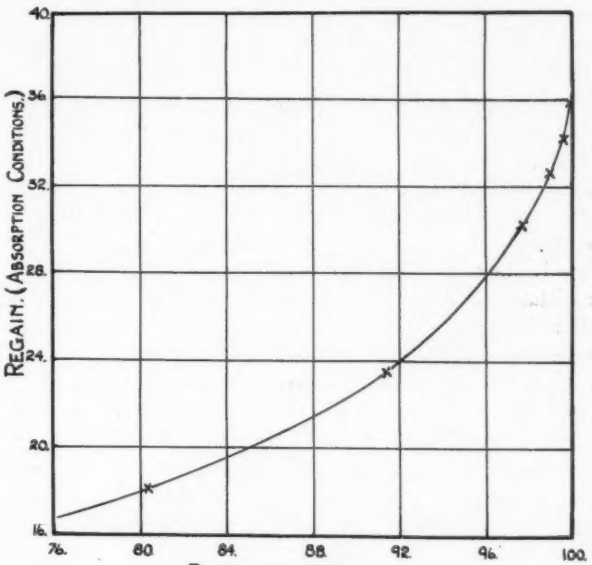

FIG 2.

value recorded.

The Effect of Temperature

The results show a decrease in the amount of moisture absorbed by wool at 30° C. compared with the absorption at the lower temperature of 10° C. for the same relative humidity. Some data obtained by Speakman[6] shows this decrease in regain with rise in temperature to be true at 97.5% R.H. up to a temperature of 40° C. above which an increase in the moisture absorbed takes place. Within the range of temperatures encountered under normal atmospheric conditions, however, the general effect of a temperature rise is to cause a decrease in regain; and correspondingly, a fall in temperature increases the amount of moisture absorbed by wool. The magnitude of the hysteresis, or difference between absorption and desorption regain values, diminishes with increased temperature, showing a similarity for wool to that found in the case of cotton[7]. In the case of wool the absorption and desorption curves appear to be much more closely parallel throughout the middle portion of the relative humidity range than is true for cotton, the curves for the latter fiber showing pronounced divergence.

From the present work on wool an average figure for the separation of the absorption and desorption curves at 30° C. between 30% and 70% relative humidity is 1.6 units of regain and the corresponding figure at 10° C. is 1.9.

As a result of this decrease in the hysteresis effect with increasing temperature, the change, at constant relative humidity, in the amount of moisture absorbed by wool resulting from a change in temperature is different depending upon whether the absorption or desorption curves are compared. The absorption and desorption curves as determined, however, do not represent specific curves

[6] Speakman, Stott and Chang. *J. Text. Inst.*, 1933, *24*, T284.
[7] Urquhart & Williams. *J. Text. Inst.*, 1924, *15*, T559.

upon one of which the regain value of the wool must lie, but define a boundary region. In other words, they define an area in any part of which the moisture content of the wool may fall depending upon the previous humidities and temperatures to which it had been subjected. If, for example, a wool which had been dried was exposed to 70% relative humidity until equilibrium had been reached the regain obtained would be on the boundary absorption curve. If the wool were now placed in a slightly lower relative humidity, the wool would not reach an equilibrium moisture value on the desorption boundary curve corresponding to the lower humidity, but would attain some value intermediate between the extreme absorption and desorption regain values for that humidity.

Where material is subject to constant fluctuations in relative humidity and temperature, such as occasioned by atmospheric changes, regain values lying in between the boundaries of the absorption and desorption curves will generally arise. Such values will be scattered around an intermediate curve which joins the desorption boundary curve at a low relative humidity and the absorption boundary curve at a high relative humidity. The extent of the scattering around this intermediate curve will depend upon the extent of regain changes uninterrupted by reversals in direction. The exact humidity values where the intermediate curve joins the boundary curves will depend on the extremes of humidity experienced. In the limit these will be 0 and 100% relative humidity and the intermediate curve will correspond to the mean of the absorption and desorption curves. To compare regain values at different temperatures, it is desirable to eliminate hysteresis effects from consideration; and this is best effected by comparing the mean regain curves referred to. Table III and Fig. 3 give the mean values for regains found at 10° C. and 30° C. for Sample A taken from the curves of Fig. 1.

TABLE III

Relative Humidity (%)	*Mean Regain at 30°C.*	*Mean Regain at 10°C.*
5	2.8	3.9
10	4.4	5.7
20	6.5	8.1
30	8.2	10.1
40	9.8	12.1
50	11.7	14.0
60	13.6	16.1
70	15.7	18.6
80	18.3	21.3
90	22.7	25.7
95	26.8	29.2
97	29.6	31.3

The effect of temperature change on the moisture content of wool, considering normal atmospheric temperatures, increases in magnitude, when expressed in terms of absolute regain units, from dryness up to about 80% R.H. after which a decrease takes place as saturation is approached. Considered as a percentage change, a change in temperature causes a change in regain of decreasing magnitude the higher the relative humidity with which the wool is in equilibrium. The following table shows

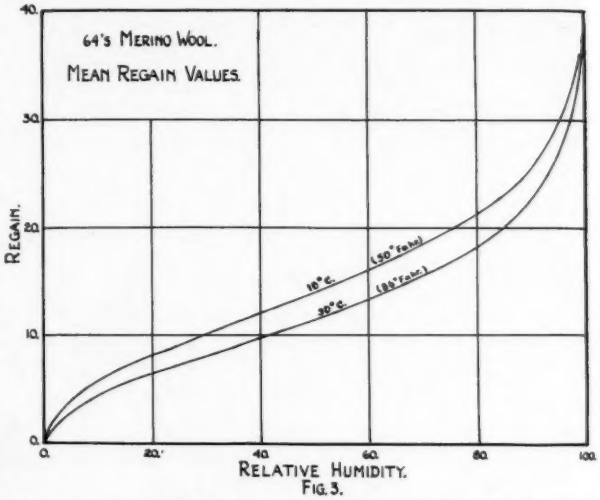

Fig. 3.

the values calculated from the results of Sample A averaged over the temperature range of the experiments, 10° C. to 30° C.

TABLE IV

Relative Humidity (%)	*Change in regain per 1°C. change in temp.*	*% change in regain value per 1° C. change in temperature*
10	0.065%	1.26
20	0.080	1.10
30	0.095	1.04
40	0.115	1.05
50	0.115	0.90
60	0.125	0.84
70	0.145	0.84
80	0.150	0.76
90	0.150	0.62
95	0.120	0.43
97	0.085	0.28

The influence of temperature on regain is therefore one of considerable magnitude. While the large changes in regain occasioned by changes in relative humidity tend to obscure its importance, it is an effect which, apart from its scientific significance, had a definite commercial importance, particularly in countries where a wide range of temperature is experienced over the twelve months of the year. For example, wool in equilibrium with 70% relative humidity at 50° Fahr. would lose over 2% of its total weight in coming to equilibrium with an atmosphere of the same relative humidity at 80° Fahr.

SUMMARY

1. Regain curves have been determined for Botany wool at 10° C. and 30° C. (50° Fahr. and 86° Fahr.)

2. For this temperature range, the regain of wool decreases with increase in temperature, the relative humidity remaining constant.

3. The magnitude of the moisture absorption hysteresis is less at the higher temperature.

4. Between the temperature limits investigated, the average change in regain of wool with temperature change increases with increase in relative humidity up to about 80% R.H., followed by a decrease.

5. The moisture absorbing capacity of wool increases very rapidly at humidities approaching saturation.

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MARCH 11, 1935

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Analytical Methods for a Textile Laboratory

The Council of the A.A.T.C.C. believing that Dr. Scott's series of articles entitled "Analytical Methods for a Textile Laboratory" might well be brought together in book form, have proceeded with its publication. Copies may be obtained from the Secretary of the Association, Harold C. Chapin, Lowell Textile Institute, Lowell, Mass., for 75 cents.

STANDARD SILK SAMPLES

There have been prepared, under the direction of the Sub-Committee on Fastness of Dyed Silk, standard dyed silk fabrics to represent four classes of fastness to washing—namely, Class I, Class II, Class III and Class IV. These standards have been carefully dyed with the dyestuffs and according to the dyeing methods recommended in the 1931 Year Book.

The A. A. T. C. C. is prepared to furnish sets of these washing standards for a nominal charge which will cover the cost of preparation. It will be possible to accurately grade the fastness by comparing it with the standards after subjection to the standard washing tests approved by this Association. All inquiries concerning these Silk Washing Standards may be addressed to the Chairman of the Research Committee.

Louis A. Olney,
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Proceedings of the American Association of Textile Chemists and Colorists

Inconel

An Alloy for Textile Wet Processing Equipment*

By F. L. LaQUE†

THE alloy, Inconel, became commercially available as a product of The International Nickel Company, Inc., in the year 1931. It was soon found to possess good resistance to corrosion by several chemicals used in the wet processing of textiles and has been used for such purposes to a limited extent. It is too soon to estimate how important a place Inconel will occupy in the textile industry; based on our experience with Monel metal it appears that Inconel will probably continue to be a special material for specific purposes, the principal one of which will be the dyeing of wool with acid and chrome acid colors. Restriction of its application will not be the result of a limited usefulness, but rather will be influenced by at least two other factors, the first of which is the established suitability of such other materials as Monel metal for the majority of dyeing processes, and the second is the higher cost of Inconel.

Since Inconel is probably the newest of the corrosion resisting materials offered to the textile industry, its general characteristics may be unknown to many of the members of the Association. Therefore, a brief description of its properties will be given before a discussion of its possible usefulness as a material for textile equipment.

COMPOSITION AND MECHANICAL PROPERTIES

Inconel contains approximately 80% nickel, 14% chromium and 6% iron. Its properties as a corrosion resisting material are about what might be expected in that they combine the acid and alkali resistance of nickel with the passivating effect of chromium. As a result, Inconel has been found to be resistant to a wide variety of acid and alkaline corrosives, including those encountered in the wet processing of textiles.

The mechanical and physical properties of Inconel are listed in Tables 1 and 2. The alloy is strong (somewhat stronger than Monel metal), and it is ductile. The range of strength and ductility is such as to enable the selection of the best combination for particular needs. Inconel can be fabricated readily, being quite similar to Monel metal in its working properties.

The high value for the modulus of elasticity of Inconel is evidence of its rigidity. Its low co-efficient of expansion, which incidentally is about the same as that of steel, is useful in welding operations (by reducing buckling resulting from the local application of heat), and in operating equipment such as dye tanks subjected to wide and frequent changes in temperature.

It can be given a polished surface if desired, but such a procedure is not essential to the development of adequate resistance to corrosion, although it does effect a moderate improvement in some cases. Like many other metal surfaces, that of Inconel resists the absorption of dyes, thus permitting rapid cleaning and enabling quick changes from one shade to another in dyeing equipment.

Inconel is available in all the usual forms, such as sheets, plates, bars, rods, tubes (seamless and welded), and wire.

TABLE 1
Mechanical Properties

	Tensile Strength Lbs./In.²	*Yield Point Lbs./In.²*	*Elong. Per Cent*	*Red. in Area Per Cent*
Sheet and strip				
Annealed	80- 95,000	30-40,000	45-55	
Rod				
Annealed	80- 95,000	30-40,000	45-55	65-75
Cold drawn	100-115,000	80-95,000	20-30	
Wire				
Annealed	80- 95,000	30-40,000	45-55	
Spring temper	175-200,000			

TABLE 2
Physical Constants

Density	8.55
Co-efficient of expansion	
100°-200° F. range	
per °F.	.0000064
per °C.	.0000115
100°-1400° F. range	
per °F.	.00000896
per °C.	.0000161
Heat conductivity	3.5% that of copper
Specific heat (77°-212° F.)	.109
Melting point	
°F.	2530
°C.	1388
Modulus of elasticity	32,000,000
Modulus in torsion	10,300,000

*Presented at Annual Meeting, Dec. 8th, 1934.

†Development and Research Department, The International Nickel Company, Inc.

Inconel is amenable to fabrication by all common methods and can be welded, silver brazed and soldered. Its corrosion resistance is not adversely affected by the heat of welding, and welded parts do not require heat treatment after welding to insure or restore their corrosion resistance.

GENERAL CORROSION RESISTANCE

Inconel is, of course, of greatest interest to the textile industry as a corrosion resisting material. The alloy was developed primarily to resist corrosion and staining by organic acids, such as are found in fruits and other food products. Since organic acid solutions are commonly used in the application of dyestuffs, the alloy developed for food handling might be said to have been developed also for certain dyeing processes. An example of the resistance of Inconel to corrosion by dilute organic acids is the result of a test in boiling 2 per cent acetic acid which was found to corrode Inconel at the very low rate of less than 0.001 inch per year.

TABLE 3
Rates of Corrosion of Inconel by Sulfuric, Hydrochloric and Nitric Acids

Acid	*Rate of Corrosion in Inches Penetration Per Year**	*Conditions of Test*
5% Hydrochloric	0.125	Cold, fully aerated, 16 ft. per minute flow.
5% Sulfuric	0.125	Cold, fully aerated, 16 ft. per minute flow.
5% Sulfuric	0.009	Cold, air free, 16 ft. per minute flow.
5% Sulfuric	0.200	Hot, fully aerated, 16 ft. per minute flow.
5% Nitric	0.22	Cold, fully aerated, 16 ft. per minute flow.
25% Nitric	0.002	Cold, fully aerated, 16 ft. per minute flow.
45% Nitric	0.001	Cold, fully aerated, 16 ft. per minute flow.
65% Nitric	0.003	Cold, fully aerated, 16 ft. per minute flow.

*The depth to which uniform corrosion would penetrate a surface of the metal exposed to the corroding solution continuously for a year.

Data on the resistance of Inconel to sulfuric, hydrochloric and nitric acids are given in Table 3. Of course, these acids in the concentrations covered by the data cited are rarely encountered in the textile industry. These data are included as a general indication of the resistance of Inconel to chemical attack. This is demonstrated, especially by the test in hydrochloric acid. The fact that Inconel withstands such a highly corrosive solution as aerated, 5 per cent hydrochloric acid as well as it does is impressive evidence of its inherent resistance to corrosion. It may be said here that, in general, the presence of chromium is not beneficial to the resistance of an alloy to corrosion by such acids as sulfuric acid and, more especially, hydrochloric. An exception to this general rule may be brought about by the presence in dilute sulfuric acid of oxidizing agents which tend to keep the chromium alloys passive. For this reason Inconel is inferior to both Monel metal and pure nickel in resistance to corrosion by hydrochloric acid under all conditions and by sulfuric acid under reducing conditions. Because of the passivating effect of chromium Inconel is considerably better than nickel and Monel metal in regard to resistance to corrosion by nitric and nitrous acids.

Although chromium may be detrimental to resistance to corrosion by concentrated alkalies, the high nickel content of Inconel compensates any effect in this direction with the result that Inconel is resistant to attack by alkaline solutions. A beneficial effect of chromium is to increase resistance to sulfur compounds. As a result of the combined effects of nickel and chromium, Inconel has been found to be highly resistant to alkaline sulfur compounds. For example, a number of alloys were tested in a boiling, concentrated (50 per cent) solution of sodium sulfide where the indicated rate of attack of Inconel was equivalent to penetration at a rate of only about 0.004 inch per year. Inconel was considerably more resistant than any of the other materials tested. The results of this test are indicative of the sutiability of Inconel for the considerably less drastic conditions of exposure encountered in the application of sulfur colors or the desulfurization of viscose rayon with sodium sulfide solutions.

As mentioned previously, Inconel is very resistant to corrosion by caustic solutions as was shown by a test in which specimens were exposed within an operating vacuum evaporator in which sodium hydroxide was concentrated to 70 per cent at 260° F. The results showed Inconel to be practically free from attack, the rate of penetration being less than 0.0001 inch per year.

LABORATORY TESTS IN TEXTILE PROCESSING SOLUTIONS

Since Inconel was first introduced a number of corrosion tests in solutions used for textile dyeing and other processes, and of determinations of the effects of Inconel on certain sensitive dyestuffs have been carried out in the laboratories of several independent companies, as well as in the Research Laboratory of The International Nickel Company, Inc. Since the results of these tests are pertinent to the present discussion, they will be described briefly.

As mentioned previously, the greatest interest in Inconel has been in connection with the dyeing of wool with acid and chrome acid colors. The reason for this has been that while Monel metal, for example, is entirely adequate for almost all acid and chrome acid colors, there are a few of these, especially when dyed in light or pastel shades, that are sufficiently affected to require special manipulation of the dyeing formulae to accommodate the

TABLE 4

Effects of Inconel on Several Sensitive Dyestuffs

Dyestuff	*Colour Index No.*	*How Dyed*	*Effect of Inconel*
Alizarine Yellow 2G	36	Top Chrome	Slightly redder and brighter
Acid Alizarine Violet	169	Top Chrome	Practically no effect
Eriochrome Blue Black R	202	Top Chrome	Slightly greener and duller
Eriochrome Black T	203	Top Chrome	Practically no effect
Eriochrome Red B	652	Top Chrome	Slightly yellower
Alizarine Cyanine Green	1078	Top Chrome	Practically no effect
Anthraquinone Violet	1080	Top Chrome	Slightly brighter
Alizarine Sky Blue B	1088	Top Chrome	Practically no effect
Monochrome Brown BC Conc. S	....	Top Chrome	Very slightly yellower
Wool Fast Orange GA	....	Top Chrome	Very slightly yellower
Acid Anthracene Brown B	....	Top Chrome	Practically no effect
Metachrome Red G	....	Top Chrome	Practically no effect
Metachrome Olive GG	....	Top Chrome	Practically no effect
Eriochrome Grey SGL	....	Top Chrome	Practically no effect
Metanil Yellow	138	Acid	Slightly greener
Azo Yellow	146	Acid	Practically no effect
Azo Rubine	179	Acid	Very slightly bluer
Xylene Light Yellow	639	Acid	Practically no effect
Alizarine Saphirol B	1054	Acid	Practically no effect
Alizarine Rubinol	1091	Acid	Practically no effect
Alizarine Direct Blue A2G	....	Acid	Slightly greener and brighter
Wool Fast Orange GA	....	Acid	Slightly redder
Alizarine Irisol R	....	Acid	Very slightly greener

effects of the metals on the dyestuff. While there seems to have been considerable and continued progress in the development of dyestuffs less sensitive to metals, the ultimate in this direction has not yet been reached. It has been natural, therefore, that those most interested in a new material for dyeing equipment have been those who are most concerned with the effects of metals on dyes and that, in examining such a new material as Inconel, they would make dyeing tests using those dyestuffs which experience has shown to be most sensitive to metals. Typical results of tests of this kind are given in Table 4, which includes observations by several independent investigators.

It will be noted that Inconel appears to have no important effect on the several sensitive dyestuffs included in the tabulation. Practical experience has tended to confirm the results of these laboratory tests.

At this point it seems desirable to draw attention to the fact that dyeing tests may be seriously misleading unless the conditions of actual practice are closely duplicated in the laboratory. Among the factors that require control are the obvious ones having to do with the proper ratio of exposed metal area to volume of the dyeing solution and the proper ratio of solution volume to the weight of the goods upon which the concentrations of dyeing chemicals are based. A less obvious factor that must be considered is the proper degree of aeration of the dyeing solution. Control of aeration is important, not only because of the profound effect of dissolved air (oxygen) on the corrosion of metals, but because of a definite indication that the concentration of dissolved air has an important influence on the sensitivity of dyestuffs to the effects of metals. Certain dyestuffs appear to be considerably more sensitive to metals in the absence of air than when the dyebath is fully aerated. Neglect of the important factor of aeration is believed by the author to be at least partly responsible for the occasional lack of agreement between the results of laboratory tests and practical experience.

The results of laboratory tests of corrosion resistance are always limited in their practical application by the wide variation in conditions of exposure among the several types of dyeing machines and from plant to plant. However, since they are at least indicative of what may be expected under operating conditions approximating those of the tests, the results of some tests in textile processing solutions are described in Tables 5 to 10.

TABLE 5

Laboratory Corrosion Test During Top Chrome Dyeing of Wool with Acetic Acid

Duration of Test: About 24 hours.
During the test the solution was agitated and aerated by movement of the cloth being dyed.

RESULTS

Metal	*Corrosion Rates* — *In Mg. per Sq. Dm. per 24 Hours*	*In Inches Penetration per 2000 Hours**
Inconel	0	0.0000
Monel Metal	11	0.0004
Nickel	60	0.002

*The depth to which uniform corrosion would penetrate a surface of metal exposed to corrosion continuously for 2000 hours. The 2000-hour period is taken to be equivalent to the actual operating time of a piece of dyeing equipment during a normal year. For higher or lower rates of operation the figures can be adjusted accordingly.

It will be observed from the data of Tables 5 and 7 that Inconel is practically completely resistant to corrosion by the mixtures of acetic acid and sodium dichromate encountered in the chrome dyeing of wool. It is also resistant to sulfuric acid dyebaths as indicated by Tables

TABLE 6

Laboratory Corrosion Test During Process of Experimental Dyeing of Wool with Sulfuric Acid

Duration of Test: About 24 hours.
During the test the solution was agitated and aerated by movement of the cloth being dyed.

RESULTS

Metal	*Corrosion Rates*	
	In Mg. per Sq. Dm. per 24 Hours	*In Inches Penetration per 2000 Hours*
Inconel	15	0.0006
Monel Metal	10	0.0004
Nickel	69	0.0025

TABLE 7

Laboratory Corrosion Test in Acetic Acid-Sodium Dichromate Solution Boiling in Vessel Fitted with Reflux Condenser

Duration of Test: 3 days.
Aeration of Dyebath: Both fully aerated and unaerated as indicated.
Movement of Specimens: None.
Composition of Solution:

Glauber's Salt	8 grams
28% Acetic Acid	2 grams
Sodium Dichromate	0.6 gram
Water	1000 cc.

Metal	*Corrosion Rates*			
	In Mg. per Sq. Dm. per 24 Hours		*In Inches Penetration per 2000 Hours*	
	Fully Aerated	*Unaerated*	*Fully Aerated*	*Unaerated*
Inconel	0.0	0.6	0.00000	0.00002
Monel Metal	0.8	2.4	0.00003	0.00009
Nickel	2.2	3.7	0.00008	0.00014

TABLE 8

Laboratory Corrosion Test in Sulfuric Acid Dye Bath Boiling in Vessel Fitted with Reflux Condenser

Duration of Test: 1 day.
Aeration of Dyebath: Both fully aerated and unaerated as indicated.
Movement of Specimens: None.
Composition of Solution:

Glauber's Salt	8 grams
66° Bé. Sulfuric Acid	1.6 grams
Water	1000 cc.

Metal	*Corrosion Rates*			
	In Mg. per Sq. Dm. per 24 Hours		*In Inches Penetration per 2000 Hours*	
	Fully Aerated	*Unaerated*	*Fully Aerated*	*Unaerated*
Inconel	234	263	0.009	0.010
Monel Metal	16	10	0.0006	0.0004
Nickel	115	69	0.004	0.0025

TABLE 9

Laboratory Corrosion Test in Textile Processing Solution as Used for After-Treatment of Direct Colors

Duration of Test: 16 hours.
Aeration of Solution: Unaerated.
Movement of Specimens: 15.5 feet per minute.
Temperature: 185° F.
Composition of Solution:

Acetic Acid	1%
Copper Sulfate	2%
Sodium Dichromate	2%

RESULTS

Metal	*Corrosion Rates*	
	In Mg. per Sq. Dm. per 24 Hours	*In Inches Penetration per 2000 Hours*
Inconel	1.4	0.00005
Monel Metal	28	0.001
Nickel	3.2	0.0001

TABLE 10

Laboratory Corrosion Test in Diazotizing Solutions

Duration of Tests: 30 minutes.
Aeration of Solutions: Unaerated.
Movement of Specimens: 16 feet per minute.
Temperature: 45° F.
Composition of Solutions:

	Solution A	*Solution B*
Sodium Nitrite	6 grams	1 gram
Concentrated Hydrochloric Acid	15 cc.	2.5 cc.
Water	1 liter	1 liter

RESULTS

Metal	*Corrosion Rate in Mg. per Sq. Dm. Per Hour*	
	Solution A	*Solution B*
Inconel	3	0
Monel Metal	1812	170
Nickel	734	...

TABLE 11

Plant Test in Rotary Skein Dyeing Machine

Specimens were mounted on a spool type specimen holder* which was placed on the bottom of the dye tank.
Duration of Test: 24 days during which 47 lots were dyed for an average period of 5 hours each.
The types of dyeing included regular acid, chrome acid (top chrome) and Neolan colors on wool skeins using sulfuric, formic and acetic acids.

RESULTS

Metal	*Corrosion Rates*					
	In Mg. per Sq. Dm. per 24 Hours			*In Inches Penetration per 2000 Hours*		
	1st 17 Lots	*2nd 30 Lots*	*Total 47 Lots*	*1st 17 Lots*	*2nd 30 Lots*	*Total 47 Lots*
Inconel	5	0	2	0.0002	0.0000	0.00007
Monel Metal	62	82	74	0.002	0.003	0.003
Nickel	187	106	133	0.007	0.004	0.005

*For description see Industrial & Engineering Chemistry, Vol. 25, Page 1311, December, 1933.

TABLE 12

Plant Test in Rotary Fur Hat Dyeing Machine

The specimens were fastened to, but insulated from, the rotating cylinder of the machine.
Duration of Test: 159 days during which the machine was operated 8 hours per day.
Dyeing Solutions: Acid dyes using either 10% of 56% acetic acid or 1¾% 66° Bé. sulfuric acid plus 20% Glauber's Salt. All percentages were based on the weight of the goods.

RESULTS

Metal	*Corrosion Rates*	
	In Mg. per Sq. Dm. per 24 Hours	*In Inches Penetration per 2000 Hours*
Inconel	10	0.0004
Monel Metal	80	0.003
Nickel	126	0.005

TABLE 13

Plant Test in Hand Dyeing Kettle

The specimens were mounted on a spool type specimen holder* and immersed in the dye liquor.
Duration of Test: 25 working days during which dyeing was carried on for 93 hours.
Dyeing Solutions: Acid dyes on wool skeins using formic and sulfuric acids at 200° F. Also for 9 hours vat dyes with caustic soda and sodium hydrosulfite.

RESULTS

Metal	*Corrosion Rates*	
	In Mg. per Sq. Dm. per 24 Hours	*In Inches Penetration per 2000 Hours*
Inconel	27	0.001
Monel Metal	168	0.006
Nickel	321	0.012

*For description of specimen holder see Industrial & Engineering Chemistry, Vol. 25, Page 1311, December, 1933.

6 and 8. However, where resistance to corrosion by sulfuric acid is the only consideration, Inconel offers no advantage over Monel metal and may even be inferior. The indicated rate of corrosion of Inconel in Table 8 appears to be unusually high when compared with that shown by Table 6 and the results of practical tests in actual dyeing equipment to be described. See Tables 11, 12 and 13.

The data of Table 9 are included principally as confirmation of the results of the other tests in oxidizing solutions of acetic acid, and as an indication of the suitability of Inconel for "after-treatment" processes using solutions of the type covered by the test.

The results of the test referred to in Table 10 are of special interest, since they indicate that Inconel will provide a satisfactory solution to the problem created by the extraordinary corrosiveness of the nitrous acid solutions used in the diazotization of developed colors. While Monel metal has been used for this purpose, it has not been entirely satisfactory because, under certain conditions, its useful life may be limited. Since Inconel appears to be as much as five hundred times as resistant as Monel metal to corrosion by diazotizing solutions, its use for such equipment is indicated. It should be noted that the conditions under which the tests described in Table 10 were carried out were especially severe, due to the fact that there was no dyestuff present to react with the nitrous acid and thereby to cut down the amount available for corrosion of the metals.

PLANT CORROSION TESTS IN TEXTILE PROCESSES

As mentioned previously, the results of laboratory tests are often rendered uncertain either by the complete lack of control of important variables, or by the difficulty of deciding what factors should be controlled and of reproducing them in the laboratory. A simple solution to this problem has been to make corrosion tests by exposing specimens in operating equipment, such as dyeing machines under the actual conditions of service. It is necessary to be careful to avoid galvanic effects by insulating specimens of different materials from each other and from the metals in the equipment in which the tests are conducted. A determination of the losses in weight over a period of time of specimens so exposed, supplemented by careful inspection of the specimens for pitting and other forms of local attack provides a fair means of estimating the suitability and probable durability of materials as used for the equipment concerned.

Inconel has been included in some tests of this kind with the results shown by Tables 11 to 15.

The data of Tables 11 to 13 refer to wool dyeing processes. While more data of this sort would be welcome, it is reassuring to find that the results that are available have confirmed the indications of the laboratory

TABLE 14
Plant Test in Rayon Desulfurizing Process

The specimens were exposed on a spool type specimen holder to fumes from desulfurizing solutions.
Duration of Test: 100 days.

Metal	*Corrosion Rates*	
	In Mg. per Sq. Dm. per 24 Hours	*In Inches Penetration per Year (8760 Hours)*
Inconel	1.5	0.00025
Monel Metal	3.3	0.00055
Nickel	1.0	0.00017

TABLE 15
Plant Test in Print Ager Handling Rapidogen Colors

The specimens were exposed on spool type specimen holders to both vapors and condensate in the print ager.
Duration of Test: 180 hours in vapors; 300 hours in condensate.
Chemicals Used: Mixture of 6 parts 56% acetic acid and 1 part 90% formic acid added to ager at rate of 12 quarts per hour.

RESULTS

Metal	*Corrosion Rates*			
	In Mg. per Sq. Dm. per 24 Hours		*In Inches Penetration per 2000 Hours*	
	In Vapors	*In Condensate*	*In Vapors*	*In Condensate*
Inconel	45	87	0.0017	0.0032
Monel Metal	49	48	0.0018	0.0018
Nickel	67	66	0.0025	0.0025
Mild Steel	2260	+13550*	0.108	0.64

*Minimum rate since the specimens of steel were destroyed during the first 180 hours of test.

tests previously described in regard to the corrosion resisting properties of Inconel. It is interesting to note from Table 12 that there is a tendency for corrosion of Inconel to decrease with time.

The data of Table 14 should be of interest to operators of viscose rayon plants, since they indicate that Inconel, Monel metal and nickel possess useful resistance to corrosion by the fumes from rayon desulfurizing processes. Nickel is probably superior to the other materials because of its slightly lower weight loss and the greater tenacity of its corrosion product.

The corrosion problem created by the use of acetic acid and formic acid in the ageing of Rapidogen colors has been an especially troublesome one. Therefore, the data of Table 15 should be of some interest. The high rate of corrosion shown by steel in the tests covered by Table 15 demonstrates the severity of the corrosion conditions resulting from the use of acetic and formic acid vapors in ageing processes. It will be noted that Inconel, nickel and Monel metal possess useful resistance to such corrosion and that apparently Monel metal is the best of the three materials. Both Monel metal and Inconel are being used successfully in Rapidogen agers, the former for ager linings, rolls and shafts, and the latter for roll shafts.

Inconel, like nickel and Monel metal, has been found by test to be suitable for use with hydrogen peroxide bleaching solutions containing sodium silicate and ammonium hydroxide. A valuable characteristic in this

respect is its lack of catalytic effect on the decomposition of alkaline, hydrogen peroxide bleaching baths.

Sodium and calcium hypochlorite solutions containing free chlorine in the concentrations used for bleaching in dyeing equipment appear to be somewhat less corrosive to Inconel than to Monel metal. However, for the present, at least, Inconel should be used in contact with solutions containing not more than three grams per liter of available chlorine and with such solutions its use should be restricted to cyclic bleaching processes where the bleach bath is followed by rinsing and souring solutions in the same machine. Inconel should not be used in continuous contact with chlorine bleaching solutions of any strength, nor as a container for the transportation of stock bleach solutions of relatively high chlorine content. In common with other metals, a highly polished surface increases the resistance of Inconel to attack by solutions containing free chlorine, its corrosion by such solutions is also inhibited by very small concentrations of sodium silicate. This has also been found to be the case with both nickel and Monel metal. As little as 0.4 cc. of 1.4 specific gravity sodium silicate solution per liter has been found to reduce corrosion of Monel metal by over 500 per cent in a sodium hypochlorite solution containing 4 grams per liter of available chlorine.

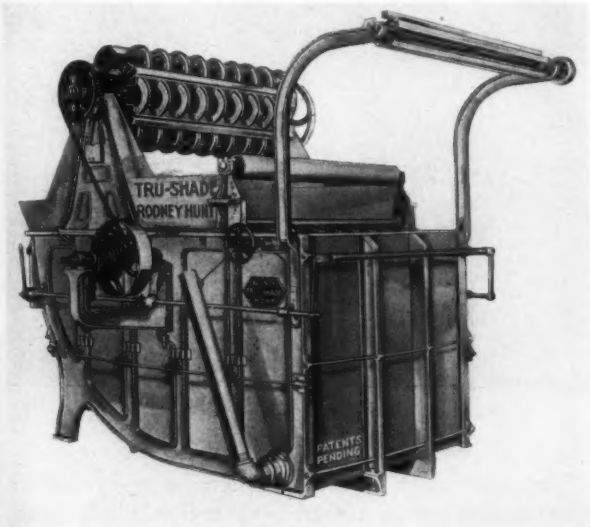

Fig. 1—Series No. 31 "Tru-Shade" all "Inconel" Dye Kettle. Manufactured by Rodney Hunt Machine Co., Orange, Mass.

Up to now Inconel has been used to only a limited extent in the textile industry. However, it has been successful in its application, as, for example, in the case of the piece goods dyeing machine of the type illustrated by Figure 1. This machine is being used for the dyeing of women's piece goods with sensitive acid and chrome acid colors. The user has reported that there has been no shade or combination of colors that could not be dyed successfully in this Inconel machine.

President Rose: Mr. LaQue, what you have said certainly gives us something to think about in connection with the new metal. To me it was very interesting to have you point out the difficulty of doing in a laboratory what people want you to do when they ask you whether a certain metal is suitable for making a dyeing machine and want you to express an opinion without giving you a chance to have a set-up that will enable you to answer them.

The next paper on our program is entitled "Recent Developments in Tensile Testing Machines," by David Scott of Henry L. Scott Co.

Mr. Scott! (Applause.)

. . . Mr. Scott read his prepared paper . . . See next page.

REPORT OF NORTH CAROLINA STATE COLLEGE STUDENT SECTION

In starting the year off almost all the members of our Student Section had the pleasure of attending the meeting of the Piedmont Section. This meeting was held in the King Cotton Hotel at Greensboro, North Carolina, on February 16, 1935. At the afternoon session Mr. Henry Dixon, an alumnus of our school and now head dyer for May Hosiery Mills, at Burlington, North Carolina, gave a paper on "Hosiery Dyeing". In addition to this paper others on various subjects were given by leading men of the Piedmont Section.

While in Greensboro we visited two plants; Ciba Dye Company and the Textile Chemical Products Company. At both plants we were greeted by former men of our Student Section who are connected with the plants. Jim Black and Dan Torrence at Ciba Dye Company and Tom Mott at the Textile Chemical Products Company. We were shown through both plants and given explanations about the manufacturing of textile compounds and dyes. While at the Textile Chemical Products Company we saw a two reel motion picture of soap making as carried on by the Iowa Soap Company at Burlington, Iowa and Camden, New Jersey. Mr. Olen D. Capps, Sales Manager, explained the process as the picture was shown.

Respectfully submitted,

A. E. SHUMATE, *Secretary.*

Proceedings of the American Association of Textile Chemists and Colorists

Recent Developments in

Tensile Testing Machines*

By DAVID C. SCOTT†

TENSILE tests—although not greatly related to conditions of use—have been for half a century or more the most reliable means of checking quality. When combined with other facts, such as weight, closeness of weave, yarn structure or size, tensile strength is certainly a yard stick for measurement of the proper processing of material. For example—when intelligently used as a control of laundering processes, a much longer life of our linen is assured.

But strength is only a part of the story. Elongation figures are of equal or greater importance (Fig. 1). If we

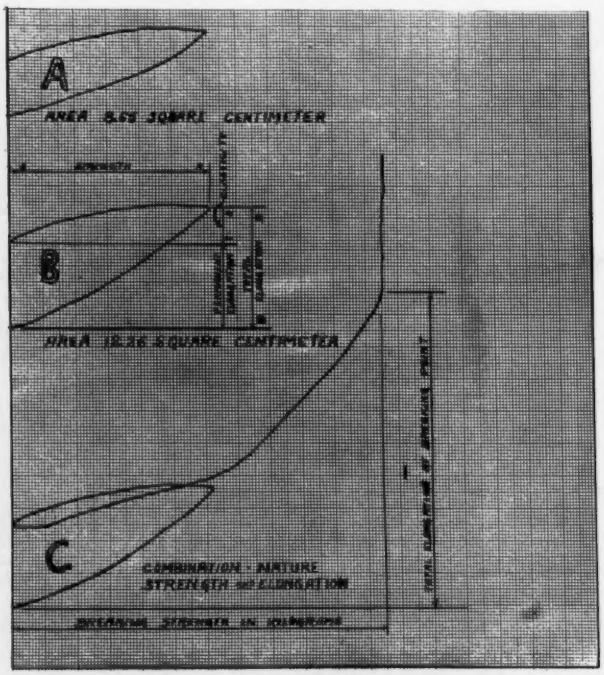

Fig. 1

know the relation of stretch or elongation to the progressively applied load, from the first application of tension to ultimate rupture, the manufacturing process, dyeing, laundering, or other treatments can be more intelligently regulated.

Fatigue or hysteresis tests, indicative of the action of the specimen under repeated loadings, are fast becoming popular in certain trade circles. (Fig. 2).

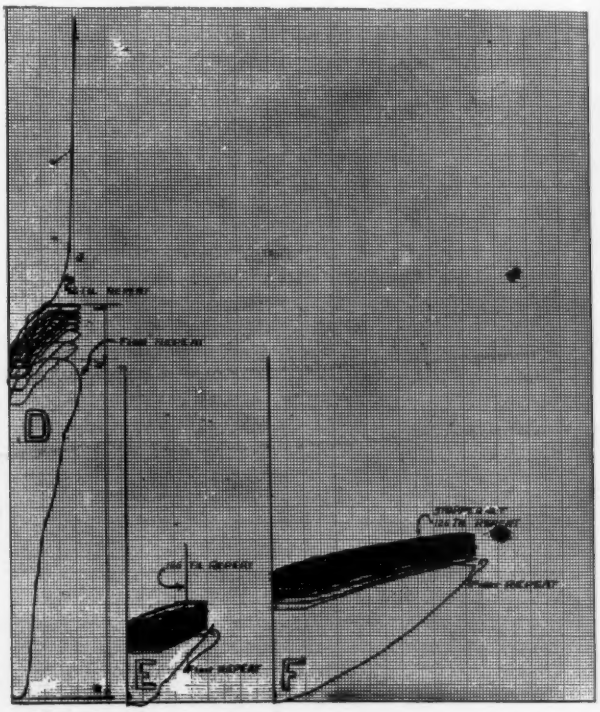

Fig. 2

The point which is the most interesting to me, in selecting cloth for my trousers is not especially how much strain will it stand before rupture, or how much will it stretch prior to break, but whether the cloth will have the ability to recover after being distorted through tension. Such information is readily obtainable. Tests of repeated loadings and unloadings of the sample can be graphically recorded, and such results in the majority of fabrics have much practical value relative to service conditions.

Since we rely so much on strength and elongation figures in evaluating our finished product, and in regulat-

*Presented at Annual Meeting, Dec. 8, 1934.
†Henry L. Scott Co.

ing our manufacturing processes, it is strange that the pendulum type of testing machine should have proven so satisfactory. (Fig. 3). A great deal of its popularity has been due to the fact that standard methods of test procedure have been specified, that the machines are of relatively simple construction, sensitive, and not subject to great variation in the results obtained (provided the machines have been carefully used and a standard procedure followed). Until recent times, too, so many other uncertainties were present that the fallacies of testing machines were not of great moment.

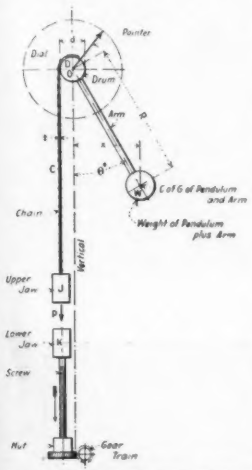

Fig. 3—Showing principle of Operation of Pendulum Type Machine.

There are several objectionable features in the pendulum type of testing machine with a transmission to move the pulling jaw at a uniform speed. First, the rate of machine load is far from constant; graphically arranged it is an irregular curve. The application of the load to a sample through a pulling jaw, moving at a constant speed, is variable according to the extensibility of the specimen and the degree of swing of the pendulum from the vertical, and hence the amount of chain unwrapped from the drum of the testing machine. It is self-evident that when the machine is testing a sample three inches long, pulling 50 pounds at full tensile with 50 per cent total elongation, the time the sample is under strain is the time for the lower jaw to travel 1½ inches (the sample elongation) plus one-half inch (the unwrap of the chain from the head drum)—a total of 2 inches at a speed of pull of 12 inches per minute or ten seconds to break. If the sample is 12 inches long, the time factor becomes one-half inch plus 6 inches or 6½ inches total travel of the pulling jaw, or 32½ seconds to break. (Table I).

That a variation of speed of the pulling jaw in testing machines greatly influences the apparent tensile strength figures, is well known by all who have used these machines, and the reason why varying lengths of specimens change tensile results can be readily appreciated when this time factor is considered. (Table II).

And when, combined with an irregular loading rate at the head or scale part of the machine, it is marvelous that the machines have been as reliable and as useful in the past. Is it any mystery that we have had little success in making yarn test figures agree when obtained from a skein of one yard, one and one-half yards, or one and one eighth meter, or a single end test when 10 inches or 20 inches, or one-half meter length is used; or that yarn strength figures seldom gave anything but an indefinite indication of fabric strength? The use of the multiple end test, as advanced by the Bureau of Standards, and in

TABLE I
Tensile Strength of Balloon Fabric as Determined by Various Testing Machines

Specimen	Pendulum Type, Capacity					Constant-Load-Rate Type, Rate of Load Application		
	800-lb. Gross	400-lb. Gross	300-lb. Gross	150-lb. Gross	150-lb. Capacity slowed down to a Rate of about 260 lb. per min.	Slow, 60 lb. per min.	Medium 110 lb. per min.	Fast, 260 lb. per min.
No. 1	70.0 lb.	69.0 lb.	67.0 lb.	62.5 lb.	61.5 lb.	62.0 lb.	69.5 lb.	69.0 lb.
No. 2	79.0 lb.	71.0 lb.	72.0 lb.	72.5 lb.	65.0 lb.	67.0 lb.	65.5 lb.	62.5 lb.
No. 3	77.0 lb.	72.0 lb.	67.5 lb.	62.0 lb.	65.5 lb.	68.0 lb.	66.0 lb.	68.0 lb.
No. 4	77.0 lb.	70.0 lb.	68.0 lb.	62.0 lb.	63.0 lb.	61.0 lb.	67.0 lb.	67.0 lb.
No. 5	73.0 lb.	70.0 lb.	68.5 lb.	67.5 lb.	53.0 lb.	67.0 lb.	68.5 lb.	64.5 lb.
No. 6	74.0 lb.	67.0 lb.	68.0 lb.	70.0 lb.	65.5 lb.	64.0 lb.	65.0 lb.	66.0 lb.
No. 7	79.0 lb.	71.0 lb.	65.0 lb.	65.0 lb.	58.5 lb.	63.0 lb.	66.0 lb.	69.0 lb.
No. 8	77.0 lb.	71.0 lb.	68.0 lb.	69.0 lb.	62.0 lb.	64.0 lb.	67.0 lb.	66.0 lb.
No. 9	74.0 lb.	67.0 lb.	68.0 lb.	63.0 lb.	58.0 lb.	64.0 lb.	70.0 lb.	66.0 lb.
No. 10	74.0 lb.	67.0 lb.	66.0 lb.	64.0 lb.	65.0 lb.	64.0 lb.	67.0 lb.	67.0 lb.
Average	75.4 lb.	69.5 lb.	67.8 lb.	65.8 lb.	61.7 lb.	64.4 lb.	67.2 lb.	66.5 lb.
Time	2.55 sec.	3.10 sec.	3.85 sec.	5.25 sec.	15.9 sec.	68.4 sec.	36.2 sec.	14.8 sec.

the so-called "Serigraph" method, has helped considerably in establishing the relation of yarn strength to fabric strength, but the difference in initial distance has interfered again, due to the above mentioned mechanical conditions. (Table III).

TABLE II

Breaking Strength of Yarns Broken at Different Speeds of Pulling Jaw[1]

Sample No.	Kind	Breaking strength of speeds per minute 1 inch Pounds	2 inch Pounds	6 inch Pounds	12 inch Pounds	20 inch Pounds
1	Rayon	124	131	141	149	152
2	Rayon	111	121	135	139	144
3	Rayon	90	94	101	105	110
4	Rayon	75	80	85	85	90
5	Rayon	85	91	102	110	115
6	Rayon	74	81	91	94	96
7	Rayon	90	95	103	109	112
8	Rayon	76	81	88	93	96
9	Rayon	73	83	92	95	98
10	Worsted	30	35	36	38	42
11	Cotton	81	80	85	86	90
12	Silk	118	125	132	147	151
13	Mercerized cotton...	138	138	139	142	145

[1]Multiple-strand method; distance between jaws was 4 inches; 200-strand specimens were used; capacity of machine was 300 pounds.

TABLE III

Breaking Strength of Yarns Broken at Different Distances Between Jaws[1]

Sample No.	Kind	Breaking strength at distance between jaws 1 inch Pounds	2 inch Pounds	3 inch Pounds	4 inch Pounds	6 inch Pounds
1	Rayon	60	60	58	58	56
2	Rayon	56	56	56	54	52
3	Rayon	45	44	43	43	41
4	Rayon	37	36	35	35	34
5	Rayon	39	38	37	37	36
6	Rayon	37	36	36	35	34
7	Rayon	46	45	44	44	43
8	Rayon	39	39	39	38	..
9	Rayon	40	40	40	39	40
10	Worsted	20	18	16	15	14
11	Cotton	41	40	37	35	34
12	Silk	60	58	54	52	50
13	Mercerized cotton...	64	59	57	55	53

[1]Multiple-strand method; speed of machine 12 inches per minute; 80-strand specimens.

Several years ago our firm invented a new form of testing machine, constructed on the principle of a weight free to move on a plane which could be so inclined as to produce a constantly increasing tension at a definite and uniform rate of load upon the sample per unit of time, irrespective of the extensibility of the specimen. (Figs. 4 and 5).

This type of test is possible because one end of the specimen is held in a fixed clamp which does not move, and the specimen is tensioned entirely by the movement of the other clamp, to which a constantly increasing load is applied by the movement of the carriage on an inclining plane. Circumstances within our organization, and also trade conditions, prevented us from generally marketing this type of machine until recently, and to date we have but four models, ranging from 250 grams

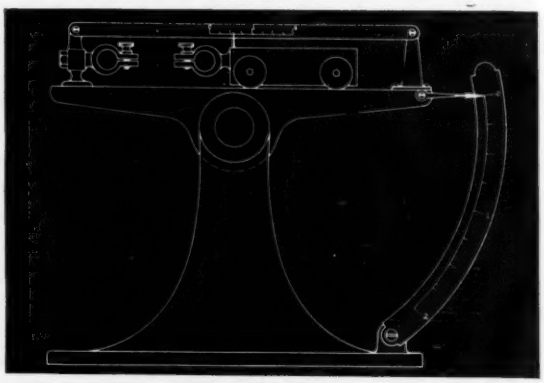

Fig. 4

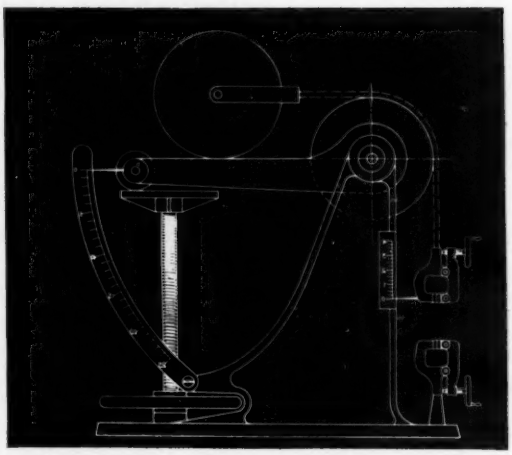

Fig. 5

maximum to 150 pounds maximum in capacity. One model is made in three capacities as standard—0 to 250 grams, 0 to 500 grams, 0 to 1,000 grams, and as this represents a rather wide spread, it is on the results obtained on this machine that I will, for the purpose of this paper, base my conclusions. (Fig. 6).

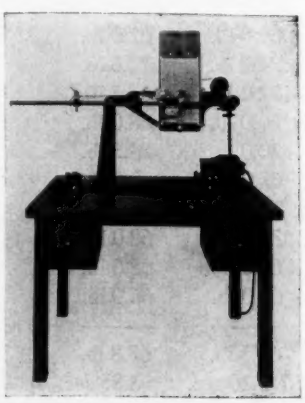

Fig. 6

The action of this machine can be reversed and it can be returned to zero load from any point in the loading stroke, thereby relieving the tension at the same rate at which it was applied. Like all other models of this type, it is an automatic recording machine. Accordingly, a fatigue or hysteresis picture or tensile curve can readily be obtained. Ten-

sile tests likewise are more simple to perform. Moreover, the results are given in true graphic form clearly defining load elongation relations. The chart forms are in rectilinear co-ordinate ruling—10 to 1"—the load direction of the graph being 10" and the stretch direction 6". The stationary clamp can be set at various distances, ranging from 0 to 20 inches, from the initial starting point of the pulling jaw, on standard machines.

The mechanism for the movement of the plane in this particular model is a three bevel reverse gear type, controlled by a typical load-fire arrangement. The latter is arranged to operate automatically and is controlled by adjustable dogs on a solid rack moving vertically to raise or lower the end of the plane. The recorder is of the flat plate type. It is so placed that it is moved through its traverse by the plane movement, imposing no load to influence machine accuracy. The stylus is of the ordinary fountain pen type and is attached direct to the carriage. The simplicity and accuracy of the arrangement is self-evident. (Fig. 7).

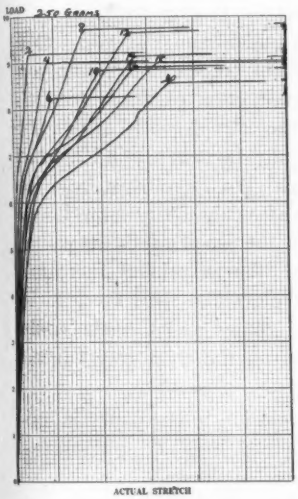

Fig. 7

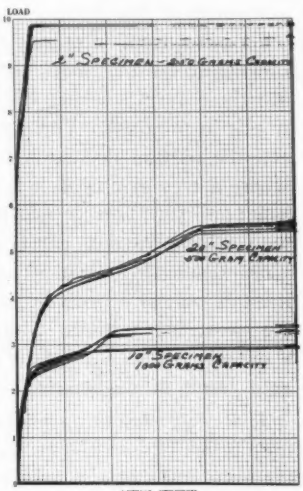

Fig. 8

Inasmuch as the same amount of load in the same period of time is applied to a yarn whether it is 2 inches or 20 inches in length, we can obtain a perfect relationship between strength and stretch on varying test lengths of samples. Thus this machine demonstrates a fact well known (but not proven heretofore by the conventional testing apparatus) that a 2 inch length is of the same strength as one of 10 inches, etc.

In changing the capacity, as is done by changing the weight of the carriage, the speed of the mechanism including the plane is not changed. Therefore we have a rate of load, when set for 250 grams capacity, of one-fourth the rate of load as when set for 1,000 grams capacity. The influence of test results of this great change in loading rate is negligible, as shown in the illustration. (Fig. 8.)

Calibration is simplicity itself—and consists of simply checking the gross weight of the carriage or, if desired, it can be done by raising a suitable float from water by a string led from the carriage over carefully mounted sheaves attached to the plane. The calibration results will be recorded on the machine graph.

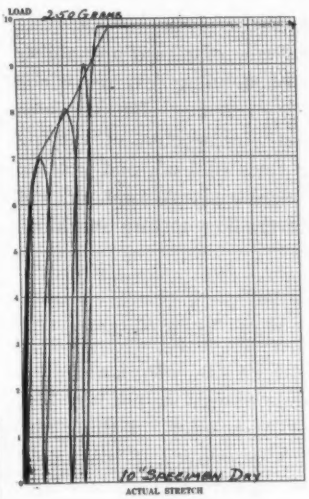

Fig. 9

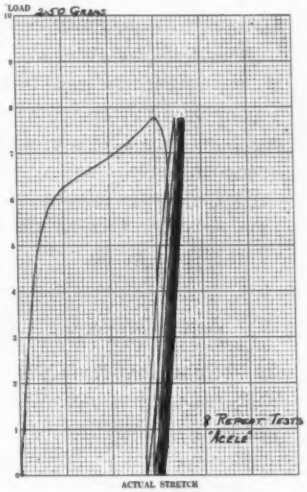

Fig.10

The illustration of the fatigue test shown is one taken of acetate rayon at 35% relative, 70 degrees Fahrenheit. The top line is a tensile test of this yarn and the loops below it are made on a companion specimen by reversing the machine at each 25 gram load increment, thereby completing relieving the load at the same rate at which it was applied. The value of such a record is obvious. (Fig. 9).

It is likewise possible to allow the machine to reverse automatically at any predetermined load, to relieve the load on the specimen and automatically reverse at zero load, and to operate in this way automatically for any length of time.

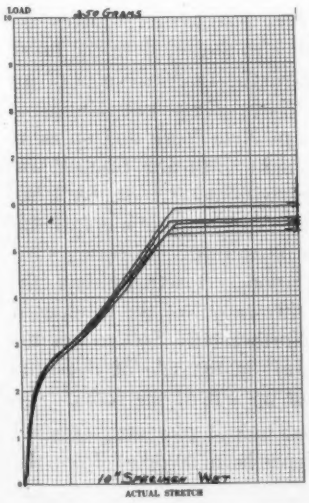

Fig. 11

The curves obtained on simple tensile tests are true stress-strains and clearly define yield, total elongation, ultimate breaking load and all such data. (Fig. 10).

The small model on the table here is one made to demonstrate the principle, and is for tensile testing only. The graph in this case is held fixed behind the plane and the ordinates are

made to suit this condition. The ruled form thereby becomes a drawing of the mathematics involved in the apparatus. Note that the *sines* of the angles are in even increments and that the *degree* of the angles vary. Note the very small amount of friction to be considered in such a machine and the extremely small chance of any change in the simple mechanism to influence the accuracy of test results. (Fig. 11).

Simplicity, sensitiveness, accuracy of record and ability to get repeat test results are outstanding features which recommend this design of testing machine. Because such machines can give accurate tests, irrespective of varying specimen lengths and varying rates of load, and because fatigue data is obtained in such a simple and efficient manner, they become the outstanding testing machines of this generation.

FOURTEENTH ANNUAL BANQUET*

(*Continued from page* [17] 19, *Jan.* 14*th issue*)

Toastmaster Wood: The Sauterne was supplied by Mr. Pfister as a compliment to the Association. I think our thanks are due to him for this generosity. (Applause.)

I am not going to introduce anybody else on this program because the next speaker is well known to you. You have his description—his pedigree—on the program, and I would like to add to that that he has endeared himself in the hearts of many young chemists by the encouragement which his own illustrious career has furnished to them, and moreover the real substantial help that I personally know he has given to them.

Ladies and Gentlemen, I give you Dr. Herty! (Applause.)

Remarks by

CHARLES H. HERTY

Dr. Charles H. Herty: Mr. Toastmaster, Ladies and Gentlemen: Sitting in my office in Savannah in the Laboratory a few days ago I heard the familiar voice of my old friend "Fritz" Howes of the DYESTUFF REPORTER asking me if I would come to New York and speak to you at your annual dinner tonight. My first reaction was one of real joy at getting back with old friends, for I had the pleasure of being at some of the early dinners of this Association. I have had the pleasure of addressing various Sections of the Association. I actually had the nerve once—expecting to be thrown out of the window of the room—to address the Northeastern Section on the question of the subject of graft in the sale of dyestuffs (laughter) but they didn't put me out of the room.

That was my first reaction: one of pleasure. Then I thought to myself, "No, I have been divorced from the dyestuff industry so long that I don't see that I fit into the picture." But here I am back again and it looks as if I can't get away from dyestuffs.

If it hadn't been for an incident that happened about ten days ago I think I should have declined the invitation anyhow, feeling that the work I am doing at present seemed to be rather far afield from your interests. Yet there has been a development in the last ten days that hooks up my work in Savannah very closely to what you men are doing at the present time and brings on what may prove to be a rather new period in textiles.

Just a few words in regard to what we are doing in the Pulp and Paper Laboratory of the Industrial Committee of Savannah which began originally as a division of the State of Georgia's forestry work but is now entirely supported by funds of the Chemical Foundation of New York City, the organization which gave us the first funds for the purchase of our equipment and by the Industrial Committee of Savannah.

You know there has been a grave misconception of the pinewood of the South, especially among paper people. That misconception is easy to understand. If you travel down through the South either by train or by motor you see these forests where the production of crude turpentine is in progress. You see these trees coated with gum and the natural deduction to any layman's mind is that where a tree gives out so much gum there must be a lot in it; and yet a simple matter of a laboratory experiment with a little sawdust cut from the wood of those young pines down there brings forth the surprising fact that there is no more resin in that pinewood than there is in the spruce of northern United States and Canada—only about one per cent. The gum on the trees is produced as a result of the wound.

That suggested at once a revolution in the paper industry of the United States, provided it would pulp satisfactorily and that was tried on a small scale in a regular sulfite mill. It was found that it pulped beautifully and bleached beautifully. With that as a start I began—in the middle of the depression with no one believing in it except the president of the Chemical Foundation—to try to raise what would eventually amount to about a half million dollars to test this out on a larger scale. We have constructed in Savannah and developed there a pilot mill with a testing laboratory, a mill where we can make about three tons of paper a day. During the last two and a half years we have been busily engaged in the producing of standard newsprint from our Southern pine.

Let me clear up one other thought before I go on to the problem that you are connected with. I say that while these young pines which have no heart in them under 25 years of age, have no more resin than spruce, nevertheless, the older trees above 25 years of age (ap-

* Dec. 8, 1934, New York, N. Y.

proximately 25) which contain heart, through some process we know nothing whatever about, that heart becomes filled with resin. So you can see how confusing it is because people in the North have known Georgia pine simply in the form of lumber, which is heart wood.

But the great tree of the South today is the young pine that has grown up since the old lumber pines were taken off by the sawmills.

In the course of this paper work we have had to make a very thorough study of sulfite pulp. We have made some 266 cooks of pinewood in our digester. We have learned how to handle it. We have bleached it. That brought up the natural thought, might not this material be useful for rayon?

Last March I got hold of the funds needed to employ some competent men, and to buy equipment for making rayon yarn. Fortunately, we secured from the Brown Company at Berlin, New Hampshire, the services of Mr. Royal Rasch who was working with George Richter on the research staff of the Brown Company, where they have been working with alpha cellulose so long.

Mr. Rasch is now at work with us, aided by two young college graduates, trained chemists, and during this past summer he has been making alpha cellulose from our pine sulfite. In cooperation with the rayon manufacturers who have sent us samples of the raw material which they use daily in their mills, and who have also sent us their methods of analysis, we have been studying commercial raw material of rayon mills in daily operation in this country. We have had most cordial cooperation from the rayon mills.

We have analyzed samples of their pulp by their methods and we have taken samples of our pulp which we make from this pine and analyzed them by the same methods, and we knew we were on the right road.

In October we sent out to eight or nine manufacturers ten and twenty pound lots of our bleached sulfite for their critical examination. Fortunately, one of them offered (if we would send it to him) to convert our alpha cellulose into rayon for us. I have brought with me tonight a sample which has been in my hands for the past ten days, and about which I said nothing until last Thursday because I wanted to get the permission of the manufacturer—whose name is well known, to let me read or publish the beautiful letter he wrote in connection with this sample.

Unfortunately, the officers of the company felt that it was against company policy to publish their letter in full. Extracts from their letter were published in the New York "Times" of December 7, 1934, and here is the sample of rayon made by one of the largest rayon manufacturing concerns in the South, where over 70 per cent of the rayon is made. I cannot give you the name of the manufacturer; I have no right to do so. I hope some day they will change their mind about that. I have their letter. But they have written to me that the processing of this pulp gave no difficulties whatever; that its color is the equal of their regular pulp; that so far as resin content, copper number, viscosity and so forth are concerned, it is fully up to commercial standards.

I have been confident all the way through that that product would eventuate from our pulps in the South but it is a real happiness to me to be able to say that not as a matter of opinion but in the light of this specimen here, which was sent to me with the label of the manufacturer, "one hundred per cent Georgia pine sulfite."

Here is its bearing on the future of the textile industry: We have gone very carefully and conservatively about our estimates of costs of production of this alpha cellulose. I tell you this frankly: That our examinations of the alpha cellulose samples which have been sent to us by the manufacturers show between 86 and 87—one as high as 88—per cent of alpha cellulose. Every one of the pulps we have examined in our laboratory so far has run between 88 and 90 per cent of "alpha."

On the matter of costs the alpha cellulose from which commercial rayon is being made today costs $70 a ton, I have a telegram to that effect. I learned this morning that that figure is a little high, from a large importer—that it is $65. This material right here not only can be, but has been, made from sulfite pulp, bleached sulfite, running 88 to 90 per cent of alpha, and can be made—including all costs, conversion costs and capital costs, I mean 6 per cent interest on the capital, 2 per cent on the sinking fund, 5 per cent for depreciation, also taxes, insurance, administration, selling costs—for $35 a ton instead of $70 a ton under those conditions that I have just listed—all those charges.

I think that has some significance for the future of the textile industry in the United States. "Well," you might say, "Have you got enough of it to amount to anything?" Now listen to me a minute. I want you to get this clear because it will give you some idea of a picture which seems unbelievable. Listen to this: There are 200,000,000 acres of cutover land in the South today that are not needed for agriculture, for they are cutting down the acreage on agriculture. Every acre of that 200,000,000 is producing these young pines in spite of the carelessness of man, who felt they had no commercial value. The Forest Service of the United States says they will grow two cords of wood an acre a year but let us cut that down in half and say a cord of wood. That means that in the Southern States from Virginia out to Texas, there is growing every year at least 200,000,000 cords of pinewood.

That pinewood is 17 per cent heavier than spruce and gives 17 per cent more pulp per cord.

Two hundred million cords growing every year in ad-

dition to the great mass of the standing pines in the South today! Do you know how many cords of wood all of the paper industry and the rayon industry all over the world use? Only eighteen millions—eighteen millions is the world consumption. We are growing down there without any effort whatever—nature is doing it—two hundred millions every year.

My plea to the chemists the night before last was "For goodness sake find new uses for cellulose." And my statement to you tonight is that the South today has available when capital can be secured to build mills, material to turn out sufficient rayon to clothe the whole world and then some. I think you will see those figures justified.

The technical details of the pulping have all been worked out. The raw material is there. Here is a demonstration that it is the right material for such products as rayon. With that, I am going to close my talk and express to you the happiness it is to me to be able to show to you men who are dealing with rayon and working with it, a great new reservoir for this beautiful fiber that has already done so much in textiles, and that from the cost—the amount—seems destined to play a still greater role in the textile industry of the world.

Thank you very much! (Applause.)

Toastmaster Wood: Thank you, Doctor Herty, for this very fine address. I am quite sure a great many of our members will like to spend a few minutes looking at this specimen of rayon that you brought with you. I can foresee a very great future at least for the State of Georgia and probably for the entire South. Instead of growing cotton they will probably grow pine trees from now on.

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UNEMPLOYMENT REGISTER

Members of this association, who are without employment, should forward to the secretary a statement as to their qualifications and experience. This information will subsequently appear on these pages with an identifying key number. Employers are also requested to file with the secretary any vacancies which may occur in their businesses.—H. C. Chapin, Secretary, Lowell Textile Institute, Lowell, Mass.

Key: A—Laboratory and research; B—Dyeing or printing; C—Finishing; D—Sales; E—Instruction; F—Executive

Note. Persons who have obtained employment should notify the secretary at once. Prospective employers may file vacancies either with the secretary or the American Dyestuff Reporter.

A-3

Education—Ph.B., Brown University, 1920. Two years post-graduate work at M.I.T.

Experience—2 years instructor at M.I.T. 2 years as research chemist in print works (Gum thickenings, application of dyes, dye testing and evaluation. 4 years as chief chemist in bleaching, mercerizing, dyeing and finishing plant. 4½ years as research and plant chemist in silk mills (Colorimetric work in color matching, dye testing and identification and testing of chemicals). 2 years as organic research chemist (laboratory and semi-plant research on organic chemicals, intermediates and dyestuffs). Age 35, married. Will go anywhere, references.

A-5

Education—B.T.C., Lowell Textile Institute.

Experience—Assistant chemist in carpet mill, dye tester in dye plant, research and analytical work in silk dyeing and finishing plant laboratory, plant chemist and overseer of bleaching in surgical dressing plant, assistant chemist in woolen mill. Age 29. Married.

A-6

Education—Analytical Chemistry and Dyeing Course, Lowell Textile Evening School.

Experience—Seven years as print color and dye chemist in printing, dyeing and finishing plants; recently in charge of textile printing department of dyestuff manufacturer.

A-8

Education—B.T.C., Lowell Textile Institute.

Experience—Assistant chemist in carpet mill, five years; dye testing, analytical and general mill control work. Age 29, married.

A-B-2

Education—Lowell Evening Textile School, 1917.

Experience—Five years' experience in hosiery dyeing, full fashioned hosiery of silk and cotton and silk, also men's hosiery containing rayon, wool, cotton and celanese. Several years experience in laboratory work. Has also had experience in jig-dyeing of cotton piece goods, slub and top dyeing.

A-B-4

Education—B.T.C. 1934, Lowell Textile Institute.

Experience—Assistant chemist in cotton knitting plant; second-hand in woolen knit goods dye house. Will go anywhere; references.

A-B-5

Education—Graduate of the University of Lausanne, Switzerland. Doctor's degree in Chemistry. Knowledge of French and German.

Experience—Eleven years with large bleaching, dyeing, printing and finishing plant as assistant Chemist and then Chemist in charge of the Laboratory. Experience in dyeing and printing cotton and rayon fabrics; research and analytical work.

A-B-C-1

Education—Graduate Industrial Chemical Engineer, Pratt Institute—1911.

Experience—One year as plant control chemist, 4 years as laboratory chemist with gas company, 13 years as plant chemist with bleaching, dyeing and finishing plant. (Rayon and cotton piece goods). Formulated processes and put them into plant operation, 1 year as chemist and demonstrator for dyestuff company, 1 year as superintendent colorist with print works printing linen and rayon, 1 year as director of testing laboratory for national dry goods concern.

A-B-C-2

Education—Graduate of Lewis Institute of Engineering of Chicago and graduate of Philadelphia Textile School (Chemistry and Dyeing department).

Experience—Has had extensive experience as assistant chemist and colorist in silk printing, dyeing and finishing; also dyeing raw stock wool; and dyeing and finishing cotton and rayon. Age 30; married; references.

A-B-C-3

Education—3 years at Brown University and Drexel Institute.

Experience—2½ years in dyestuff laboratory; 3 years as second-hand, dyeing indanthrene and direct colors on rayon skeins; 6 months as boss dyer on silk and cotton ribbons and hosiery; 3 years overseer of dyeing and finishing rayon tubing. Can handle laboratory, dyehouse, finishing or outside service. Age 30; married.

A-B-D-1

Education—Graduate, New Bedford High School, 1930; New Bedford Textile School, 1933 (chemistry, dyeing and finishing).

Experience—16 months' general experience in print works, on all type machines and special experience in application of direct, sulfur, developed and naphtol dyes and color matching. Desires position in dyehouse, laboratory or sales. Age 22; references.

A-C-1

Education—4 years at Newark Evening Technical School in Chemical Engineering.

Experience—8 years in manufacturing, research, testing of soaps, oils, gums and finishes and application of same in all phases of the textile industry. Age 23, single. References.

A-E-1

Education—Ph.D., Univ. of Illinois, studied chemical engineering at Columbia, licensed chemical engineer, New Jersey.

Experience—10 years' experience teaching in colleges, subjects included chemical and textile subjects. Has had broad experience in industrial work including experience in testing materials, research and consulting. Will go anywhere; references.

B-1

Education—Educated and trained in chemistry and calico printing in Glasgow, Scotland.

Experience—Has been with large print works as colorist for 13 years producing first class work on cotton, rayon, wool and silk fabrics. References.

B-2

Experience—Boss dyer with one firm for 18 years, divisional supt. at print works for 1 year, in charge of processing and dyeing of cottons and rayons at large bleachery for 6 years. Prefers bleachery in East but will go anywhere. References.

B-3

Experience—Foreman piece dyer for the past 21 years. Can dye the following; celanese, rayon, cotton lacks, wool, silk and mixed fabrics. Has knowledge of finishing and laboratory work.

B-6

Education—Graduate R. I. School of Design.

Experience—5 years in bleachery, 7½ years as assistant dyer, 2 years as boss dyer and 3 years as superintendent of dyeing and finishing. Married, 33 years old. References.

B-7

Experience—Eight years as boss dyer on skeins and ribbons. Over ten years as chemist and head dyer for a large hosiery mill. Experienced on Silk, cotton, rayon and wool in skeins, ribbons, piece goods and all kinds of mixtures. Willing to go anywhere. Not afraid to work or face responsibility. Can handle help efficiently.

B-8

Education—Chemistry and Dyeing Department, Philadelphia Textile School.

Experience—Eleven years experience as chemist and boss dyer on the following: woolen, worsted and cotton yarn; woolen, worsted and union piece dyes on both ladies' and men's wear; wool, cotton, shoddy and mohair raw stock. Age 33, married, will go anywhere. References.

B-9

Experience—Hosiery dyer with fifteen years' experience on high grade silk hosiery; familiar with all types of machines. Age 43, married. Will go anywhere.

B-12

Education—2 years days at N. Y. U. and 3 years nights studying chemical engineering.

Experience—1½ years asst. colorist, 5½ years colorist. Experienced on vats, commercial and fast colors on cotton and cotton-rayon mixtures. References; age 29; married.

B-13

Experience—Large experience as an assistant colorist chemist in silk printing, dyeing and finishing; also on cotton and wool dyeing. References.

B-14

Education—Rhode Island School of Design.

Experience—Familiar with all classes of wool dyeing. Seven years with large carpet mill as dyer and processor of washed oriental rugs. Will go anywhere, married, 37 years old. References.

B-15

Education—B.T.C., Lowell Textile Institute, 1934.

Experience—Experience in dye house running washers, dye kettles and as a dye weighter.

B-16

Education—Chemistry and Dyeing Dept., Philadelphia Textile School.

Experience—Head dyer and chemist on all types of hosiery; dyeing silk, cotton, Bemberg, rayon and unions of same; Celanese and immunized cotton effects. Age 27, married. Will go anywhere.

B-17

Education—Lowell Textile Institute (Chemistry and Dyeing Course) 1916; extension courses at Brown University.

Experience—6 months dyeing wool at finishing company; 2½ years research work on bleaching, dyeing and finishing at dye works; inspector of textile equipment, U. S. Ordnance Dept., during war; 15 years as superintendent of dyeing at finishing company, including all types of colors on cotton piece goods and some rayon and celanese; handled chemical work at last named plant for many years as well as dyeing. Age 40, married, prefers East. References.

F-1

Education—Textile Institute, Alexander Hamilton Inst., Extension work at Brown Univ., working knowledge of German.

Experience—Has had executive departmental work with all types of textiles manufacturers. Acquainted with all types of textile machinery, dyestuff application, laboratory practice, cost methods, and checking methods and processes. References.

AMERICAN
DYESTUFF
REPORTER

LOUIS A. OLNEY, Sc.D.
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● MASTER'S DEGREE

It is reported that the Legislature's Committee on Education in Massachusetts has approved a bill which would empower the Lowell Textile Institute to confer degrees of master of science in textile chemistry and textile engineering upon completion of prescribed courses. This degree would be conferred on graduates of recognized colleges who have earned bachelor's degrees. Graduates of the Lowell Textile Institute who now have bachelor's degrees in textile chemistry or textile engineering would be able to earn the master's degree in one year while it is believed that graduates of other institutions would require two years. Among those who spoke in behalf of the bill at the committee hearing were Charles H. Eames, president of the Lowell Textile Institute, Royal P. White, chairman of the Board of Trustees at the Institute and Dr. Payson Smith, Commissioner of Education of Massachusetts.

● S.O.C.M.A. MEETING

The regular monthly luncheon-meeting of the Synthetic Organic Chemical Manufacturers Association was held at the Chemists' Club, New York City, on Thursday, February 14th, at 12:30 P.M. President Merz presided. Reports and discussions took place on the following subjects: tariff hearings, natural organic products industry's code, new food and drug bills and the A.C.S. tercentenary. The guest of the day, Morris R. Poucher spoke on various matters concerned with the background of the chemical industry and related matters. It was reported that the June outing will be held on June 6th, 7th and 8th at Skytop Lodge, Skytop, Pa. The Manufacturing Chemists' Association will hold their annual meeting at the same place on June 6th.

● CHEMICAL INDUSTRIES ANNIVERSARY

The chemical industries of America will celebrate the 300th anniversary of their founding this year, with events opening in New York April 22 at the eighty-ninth meeting of the American Chemical Society, in which the Manufacturing Chemists Association, the Synthetic Organic Chemical Manufacturers Association, and the chemical societies of the metropolitan district will participate.

Science and industry will join in an exposition of chemistry's development since John Winthrop, Jr., first colonial governor of Connecticut, in 1635 mapped out a far-reaching program for the production of salt, iron, glass, potash, tar, black lead, saltpeter, medicines, copper, alum, and other chemicals. Previously Winthrop, son of the Pilgrim governor of the Massachusetts colony, had imported apparatus, chemicals, and chemical books which formed the nucleus of the first chemical laboratory and library in this country.

At the tercentenary assembly, to be attended by more than 10,000 representatives of chemistry and the allied sciences, industry, and education, Winthrop will be heralded as the real founder of the nation's chemical industries, which have grown into giant industrial enterprises with an annual output running into billions of dollars.

Inventions, discoveries, and explorations in chemistry over the span of 300 years will be traced to show how infant industries have become the bulwark of national defense, the basis of modern industrial progress, and the source of a large and growing percentage of national wealth.

Francis P. Garvan, president of the Chemical Foundation and recipient of the Priestley Medal as "the greatest lay patron of chemistry", is honorary chairman of the New York Committee organizing the celebration. Prof. Arthur W. Hixson of Columbia University is general chairman.

A committee of the Manufacturing Chemists Association appointed to cooperate with the Society in the tercentenary arrangements consists of E. M. Allen of New York, president of Mathieson Alkali Works; Lammot du Pont of Wilmington, Del., president of E. I. du Pont de Nemours and Company; and George W. Merck of New York, president of Merck and Company.

Senator Pat Harrison of Mississippi and Representative James W. Wadsworth of New York will be among the speakers at a dinner meeting on Wednesday evening, April 24. On the same day a chemical industries symposium, planned to interpret the close relationship between

the chemical industries and the national welfare, will be held. Thomas Midgley, vice president of the Ethyl Gasoline Corporation, will deliver an address on "Chemical Developments in the Next One Hundred Years." William B. Bell, chairman of the Board of Directors of the American Cyanamid Company, will speak on "National Planning and the Chemical Industries."

Other themes at this symposium include: "What the American Chemical Industries Have Done and Are Doing for the Nation"; "New Foreign Problems confronting the American Chemical Industries"; "Scientific Foundations of the American Chemical Industries."

On Thursday, April 25, there will be a symposium on the economic problems of the chemical industry, with R. P. Soule, chemical economist of the Tri-Continental Corporation, as chairman. "Machine Age or Material Age?" is one of the topics to be discussed.

"New materials rather than new machines are characteristic of the present era," the announcement points out. "The rise of the process industries in the post-war decade will be described, the discussion centering around synthetic fuels, building materials, rubber wrappings; the encroachment upon agriculture and the products of the farm; the realignment of industries; and the outlook for the future."

Depreciation and obsolescence charges under the New Deal will be another subject of this symposium. The chemical industry, according to the announcement, is outstanding in high charges for depreciation and obsolescence. The chemists will discuss federal policy toward reducing corporate surpluses and increasing tax revenues, and will explain their attitude toward current and past depreciation and obsolescence reserves.

The question of chemical prices will also come up, the discussion involving the trend of typical prices against the background of the general price structure, below both 1914 and 1926 levels. A protective tariff, the announcement says, has not increased prices, low prices resulting in spite of high wages. Other problems to be dealt with include prices vs. earnings, trend of prices in the future, elastic and inelastic markets for chemicals.

A third symposium will be devoted to materials of construction in the building industry. The chairman will be Prof. James R. Withrow of Ohio State University. A group of papers will outline the latest developments in new materials of construction important to the chemical industries. These papers will cover a wide range of materials, including metals, ceramics, plastics, rubber, and alloys.

Sessions are scheduled by the Society's nineteen professional divisions. On Tuesday evening, April 23, the William H. Nichols medal of the New York Section of the American Chemical Society will be bestowed upon Father Julius A. Nieuwland of Notre Dame University.

● TEXTILE WARP SIZING

Another ancient textile process that is still handled in some mills about as it was a hundred years ago, is to be made the subject of scientific research. This is the sizing of cotton, rayon and other warp yarns. The study will be conducted by the Division of Industrial Co-operation, Massachusetts Institute of Technology, Cambridge, Mass., under the auspices of U. S. Institute for Textile Research, Inc. The administration of the study for U. S. Institute will be in the hands of the following committee: Mr. Wright Bolton, agent rayon division, Pacific Mills, Lawrence, Mass., chairman; Dr. J. B. Quig, Du Pont Rayon Co., New York, N. Y., and Dr. H. A. Neville, physical chemist, Lehigh University, Bethlehem, Pa.

The project has the endorsement of the Textile Foundation, of which Mr. Franklin W. Hobbs, president of the Arlington Mills, Lawrence, Mass., is chairman, the Foundation having subscribed $5,000 toward a fund of $10,000 that has been nearly completed by U. S. Institute. Among the contributors to this research fund are the following: Amoskeag Mfg. Co., Manchester, N. H.; Aspinook Co., Jewett City, Conn.; Cheney Brothers, South Manchester, Conn.; Chemical Foundation, New York, N. Y.; Chicopee Mfg. Co., New Brunswick, N. J.; Cluett, Peabody & Co., Inc., Troy, N. Y.; Corn Products Refining Co., New York, N. Y.; Du Pont Rayon Co., New York, N. Y.; Erwin Cotton Mills Co., West Durham, N. C.; Exeter Mfg. Co., Exeter, N. H.; E. F. Houghton & Co., Philadelphia, Pa.; National Oil Products Co., Harrison, N. J.; Pacific Mills, Lawrence, Mass.; Rossie Velvet Co., Mystic, Conn.; A. E. Staley Mfg. Co., Decatur, Ill.; Standard Chemical Products, Inc., Hoboken, N. J.; Stein, Hall & Co., Inc., New York, N. Y.; Stonecutter Mills Co., Spindale, N. C.; Warwick Mills, West Warwick, R. I.

The sizing, or "slashing" of warps prior to weaving is made necessary by the abnormal strain and abrasion to which the warp yarns are subjected during weaving. The sizing must provide the needed resistance to this abnormal tension and abrasion, and must be easily and completely removed from the cloth prior to its dyeing, printing or other processing. This is true of all kinds of warps, but rayons are most sensitive to the destructive action of the loom and their extensive use has accentuated the need of scientific sizing.

The scientific study of warp sizing must not only cover the mechanics of weaving and of slashing, but also some very abstruse problems in colloidal and physical chemistry. Some of the possible results of the research may be lessened deterioration of the warp by the loom; increased loom product; lessened warp twist and increased yarn production; size films whose properties are closely correlated with warp yarn properties; specifications for the sizing value of different sizing materials or mixtures that will make it possible to change the latter when advisable because of cost, etc.; improved stability of vis-

cosity or consistency of size mixtures; the effective viscosity range of sizing mixtures; a synthetic size. While these and other valuable results may be obtained the chief objective of this scientific investigation is to learn the scientific "whys" of present rule-of-thumb methods and to place warp sizing upon a scientific and controllable basis.

Final results of the study will be published in U. S. Institute's monthly magazine, *Textile Research*, and released for general publication. However, only Contributing members of U. S. Institute, paying dues of $100 a year, will be privileged to receive confidential progress reports of this research. All of the contributors to the fund have become Contributing members, or held such membership previously.

OBITUARY

FREDERICK C. WARD

Frederick C. Ward, manager of industrial sales, Colgate-Palmolive-Peet Company, died on February 15th last at the age of forty-seven. Mr. Ward joined the Palmolive Company in March, 1926 as manager of industrial sales and retained that position after the formation of Colgate-Palmolive-Peet Company in 1928.

He is survived by his wife, Mrs. Marie Habighorst Ward, and one daughter, Ruth Marie Ward.

ALBERT C. WEED

The many friends and business acquaintances of Albert C. Weed, Vice-President of Borne Scrymser Company, will mourn his sudden death caused by a heart attack as reported on Saturday, February 23rd, at his home in Manhasset, L. I.

Mr. Weed had been associated with Borne Scrymser Company continuously for a period of 45 years, having started there as a young man, and serving successively as Secretary, Treasurer and Vice-President. To his initiative and capable supervision is largely attributed the development and adoption among the cotton trade, of the patented Breton Mineral Process of oil treating cotton fibers. He had taken an active part in the affairs of his Company up to the day of his passing.

Mr. Weed was 68 years of age and is survived by a son, Lowrey A., a sister, Mrs. Robert Doye, and a brother, Eugene P. Weed, lawyer of New York City.

● GENERAL RELEASES

The General Dyestuff Corp. announces release of circulars on the following products. Copies are available upon request.

Katigen Brown G G N—a new sulfur brown manufactured by the General Aniline Works.

Developer O R B—a new devoloper for acetate silk dyeing which is said to produce a dischargeable orange shade with Cellitazol O R B.

Variamine Blue Salt B A and *Variamine Blue Salt R T A*—which differ from the old brands Variamine Blue Salt B and R T by not containing any alkali binding agent. It is stated that it has been found that in all introduced application methods of these products such additions can be eliminated.

Fastusol Orange L G G—for which is claimed exceptional fastness to light and very good leveling and solubility.

Celliton Discharge Blue 3 R—said to be the first blue dyestuff for acetate silk which is dischargeable to a pure white. This is said to give a possibility to build up dischargeable browns, navies, greens and blacks.

● TEXTILE CHEMICALS

The American Cyanamid and Chemical Corp. has released a bulletin entitled "Products used in the Textile Industry". It is stated that the folder contains, in addition to a list of the chemicals manufactured and sold by this corporation to the textile industry, a partial list of the specialty products which they manufacture for the textile industry's use. Sulfonated oils, penetrants, softeners, sizing compounds and others are included with a brief description of each one. Copies of this bulletin are available upon request.

● NEW TESTING STATION

The opening of a Brooklyn Testing Station on March 1st was announced recently by the United States Testing Company, Inc., whose main headquarters and plant are in Hoboken, N. J. The new branch of the company is located at 43 Morgan Avenue.

The new unit will be equipped to offer a complete testing service on woolen, worsted, cotton, silk, rayon and acetate yarns and fabrics. Opening of this branch marks the addition of another division to those now operating in New York, Hoboken, Chicago, Philadelphia, Paterson, Providence, Woonsocket, Greensboro, Fitchburg, Reading, Lowell and Brigeport, Pa.

● OPENS NEW OFFICE

Karl M. Herstein has announced the opening of a new office in the Chemists' Building, 50 East 41st Street, New York City. He will continue his practice as consulting chemist specializing in chemical technology and patents.

Washington News Letter

By **WALDON FAWCETT**

THE STANDARDIZATION OF SPECIFICATIONS

IF this Congress grants the plea of the National Bureau of Standards for an increase of $125,000 in the Budget for 1936, a proportion of this allowance will be devoted to the Standardization of Specifications. The effort for the unification of commodity specifications has been, all along, one of the pillar projects of the Government's testing and research laboratories. It has required, however, the developments of the past two or three years to demonstrate to what an extent a supposedly routine activity may be crippled or impeded by arbitrary economies imposed under the impression that, in a supposed emergency, efforts for standardization "can always wait".

The reason for the embarrassment in the present instance is not far to seek. Hard on the heels of the 1933 cut, which reduced the Bureau of Standards funds to one-half of 1932 appropriation, came the tremendous expansion of the activities of the Government,—notably, via the so-called alphabetical agencies. The sequel was, of course, a noticeable spurt in material purchasing to Government order in every field. That brought, in its train, a formidable increase in the volume of testing for verification of purchases,—a service that would have broken down were it not for the transfer of funds from Government Departments made possible by the Economy Act. It also brought a sudden and acute realization of the practical need for the utmost standardization of specifications. Fortunately, the Director of the National Bureau of Standards is ex-officio chairman of the Federal Specifications Board and this interlocking relationship has made it possible to bring home, in the most influential quarters the need for authoritative specifications. Equally fortunately, for the fate of the specifications program, the developments of the past two years have strengthened the alliance between the Standards Bureau and the American Standards Association, of which latter three of the staff members are now on duty at Washington for purposes of contact maintenance.

Speaking of the plight to which the Bureau of Standards has been brought, Director Lyman J. Briggs recently said: "The experience of the past 18 months has shown clearly that the services which the various Federal agencies request from the Bureau cannot be performed with our present budget. Some really essential services have had to be discontinued. Our trained key men have been obliged to curtail or discontinue their research work in order to help out with testing work which should be done by younger and less valuable men." In illustration of the burden of the extraordinary testing work he cited the thousands of tests of blankets and bedding materials conducted, this past few months, for the F.E.R.A.

Argument before Congress, then, for an increase in next year's expense account does not stop short with the direct pressure for utmost effort in behalf of standardization of specifications. Stressed also is the fact that a large proportion of the specifications evolved are based on the results of tests in the special machines maintained at the Bureau,—notably the flexometer and the compressometer designed and built in the Bureau's textile laboratory, and used very extensively this past year in measuring the flexural attributes of fabrics and the compressional characteristics. Even the most routine of the tests at the Bureau, to check procurement requirements, have strings leading to the specification angle because it is the fixed policy of the Bureau, when making such tests, to cover a representative range of materials of a given type so that the results may serve as bases for specifications.

For all the upsets of the past two or three years it must, in fairness, be conceded that one consequence of the New Deal has been advantageous to the cause of specification stabilization and consolidation. The Bureau of Standards, in connection with its work for Governmental purchasing agents and in cooperation with all specification-making agencies having national recognition, has gradually compiled a complete library of nationally-recognized specifications. It waited, however, upon the creation of the NRA and other latter-day institutions of the revolutionary period to reveal the value and usefulness of this clearing house. The specifications files at the Bureau have been the main dependency in reviewing and revising all of the Codes of fair competition to insure the insertion therein of proper references to quality standards. To facilitate this work, the specifications in the master file have been completely indexed on a classified commodity basis. Better yet, most of the specifications have been intercompared critically,—a study that appears to be destined to contribute effectively to attainment of unification of commercial standards as a national basis for marketing, identifying, selecting and accepting commodities.

By a significant interplay of action and reaction of influences, the cause of standardization of specifications is also responsive, just now, to the parallel trend to com-

modity standardization which is in itself the fruit of the introduction of the NRA Codes and equivalent inter-industrial or intra-industrial pacts. This drift to standardization is registered, therefore, no more definitely in the Division of Specifications and the Division of Trade Standards that in the sympathetic Division of Simplified Practice. Moreover it is the disposition of the producers, distributors and consumers, meeting on common ground, to evolve standardized specifications which will "go the whole distance" in prescribing grades, qualities, performance, dimensional limitations and tolerances.

In the standardization of specifications, under Governmental auspices, several problems have obtruded apart from the obvious responsibilities of enlisting disinterested team-play between the officials of technical societies and trade associations, the representatives of testing and research laboratories, and the spokesmen for the several private, public and semi-public specification-making and specification-using industries,—not to mention the conciliation of the Consumers' Advisory Board. The first problem is that of promulgation or publicity. How are standardized specifications to be made available to all parties concerned? Problem Number 2, involves the securance of that degree of flexibility or elasticity which will permit the prompt adjustment of standing specifications to altered conditions. The third problem is double-headed. Prong "a" raises the question of how the buyer or consumer is to ascertain, readily, where he may obtain articles of manufacture fabricated in accordance with the standardized specifications. Prong "b" poses the riddle of confirmation or verified compliance with standardized specifications—as this necessity for conclusive check-up is translated to the layman.

The publicity-educational factor is disposed of via the publication by the National Bureau of Standards of the Directory of Specifications, the Encyclopedia of Specifications, and other similar reference manuals. Affiliated organization channels are likewise employed to disseminate the news of amendments or amplifications. As an example of the operative method, there may be instanced the participation of the American Society of Testing Materials when improved quantitative methods of analysis were developed in order to meet the fresh demands for reliability in the analysis of cotton-wool mixtures induced by the Federal Trade Commission ruling on the labeling of part-wool underwear and the revision of the standard for part-wool blankets. The improved methods of analysis were not only incorporated in the Federal specifications but concurrently were bulletined by the Testing Materials Society.

To determine whether an applicable standard specification exists for any desired commodity, the seeker is referred to the National Directory of Commodity Specifications. Here are listed by title, designating number, and sponsoring organization, standards and methods of test for all commodities regularly produced in this country. Each specification is briefly summarized as to technical characteristics, scope, and special applications. The intent is to provide a comprehensive source-book for all specification users and specification writers, whether producer or consumer. For the actual texts of the standards and specifications the interested party is supposed to turn to the Encyclopedia of Specifications which is now emerging serially with coverage of one major group at a time.

The problem of keeping the standardized specifications up to date is, of course, one of revision and modernization,—either periodic or at the demand of occasion. Incidentally, there has been a certain amount of consolidation of early specifications. To meet in its duality the third problem of those above listed there has been developed an "intelligence" system, if it may be so styled, which is one of the most interesting aspects of the entire structure of Specification Standardization. To vouch for integrity of commodities there have been created, under Federal auspices, twin institutions that are, in many respects, unique. One is known as the Certification—to Purchaser Service. The other is designated the Self-Identifying, Quality-Guaranteeing Labeling Plan. Between them they enlist the cooperation of thousands of manufacturers.

As its name would imply, the Certification system is a method whereby producers or marketers certify,—upon the initiative of the seller or at the request of the buyer—that material supplied on contracts based on indicated Federal specifications or commercial standards actually complies with the requirements of the specifications or formula. By refinement of the certifying process, this method of credentialing has been extended from the large operators, who cover their wants by contract, to the over-the-counter buyers.

The gauge of the efficiency and sufficiency of the Certification system is to be found, of course, in the number and operative range of the willing-to-certify manufacturers who are equipped and willing to produce commodities in accordance with about 450 Federal specifications and 40 commercial standards. Indicative of the state of compliance is the situation in the textile field. In the field of yardage textiles 154 firms are enrolled for 275 listings under twenty specifications. In the classification of textile products, 214 firms have an aggregate of 465 listings under 22 specifications. Similarly indicative of numerical coverage is the roster of 70 firms who carry certifications of chemicals.

Rather impressive is the muster of advantages which are responsible for the number of enlistments under the Certification system. The first incentive has been found in the promise of Certification to make thoroughly effective the benefits to be derived by both producers and consumers from the economies inherent in mass-production, mass-distribution, and mass-consumption. Then follows the encouragement to manufacturers to turn out staple commodities that comply with nationally-recognized specifications. Indirectly, also the Certification de-

vice is counted upon to persuade trade forces to concentration on fewer and more comprehensive specifications.

As a second hostage to integrity in merchandise, the program of Standardization of Specifications has ushered in the Self-Identifying, Quality-Guaranteeing Labeling Plan. Whereas straight Certification is counted upon chiefly to win the confidence of large-quantity and medium-quantity buyers, its complement, the Guaranty-Labeling Plan, is designed mainly for the reassurance of non-contract or over-the-counter buyers. Admittedly, this Federally-administrated labeling plan is similar in certain respects to countless inspection-labeling or warranty-labeling devices which have already been placed in operation by intimate groups or have been formally endorsed by one and another of the more than one hundred technical societies and trade associations that are on record in favor of joint, cooperative pledging of characteristics and qualities in the wares thus collectively signed.

Aside from the prestige attaching to high authority, the Quality-Guaranteeing Labeling Plan administered at the National Bureau of Standards has the dual advantage that it serves to identify both the firm or association issuing the guaranty and the nationally-recognized specification which the endorsed commodity is sworn to meet. The label, it may be added, is supposed to be placed on each individual commodity or unit container. Some expense attaches to the method of proclamation and a considerable number of firms who manufacture goods on a mass-production basis have let it be known that they only wait upon assurance of sufficient demand for the labeled goods to swing into line as habitual labelers.

Only unfortunate interpretation could misconstrue Federal promotion of the Certification Plan and the Guaranty-Labeling institution as an attempt at substitution for professional scientific commodity testing as a verification of conformity to specification. The viewpoint at Washington is that the widening acceptance of the Certification and Guaranty-Labeling plans may reduce but slightly the volume of testing upon delivery. But will, at the same time increase the amount of testing in other quarters. In other words, the consequence of the invasion will be to give scientific testing a new direction, but leave it with the same ultimate objective.

The theory propounded to the writer at the Bureau of Standards is that the expansion of the Certification plan means that more manufacturers, than formerly, need testing and inspection services upon which to base their certificates, whether the latter be issued in elementary form to individual purchasers or translated into the form of labels for purchasers of bulk staple merchandise. Furthermore, to the extent that the application of the certification plan results in the use of standardized specifications by purchasers not hitherto buying on specifications it must increase the demand for testing services on behalf of these buyers.

For all its enthusiasm for standardization the Division of Specifications has cooperated consistently with testing and research laboratories. And, to strengthen what its officials have declared "would otherwise be the weakest link in the purchasing chain" and make truly effective both the certification and labeling plans, the Division has inaugurated a testing information service. There has been compiled and published in three editions a directory of the commercial testing and college research laboratories throughout the country. To the same end there has been compiled, under the authority of the Chief Coordinator, a classified directory of the laboratories of the Federal Government available for the testing of supplies and materials. The lists of commercial testing laboratories are minutely classified and are kept current to enable prompt response to the inquiries of all parties in quest of testing and research facilities.

BOOK REVIEW

The Popular Practice of Fraud. *T. Swann Harding, 376 pages. Published by Longmans, Green and Co.* 1935. *Price,* $2.50.

Apparently the old statement that "The public likes to be fooled" is as true as ever, at least one would be inclined to believe so after reading this book. Humanity has always fallen for clever charlatans, and today an unsuspecting public is still being deceived largely because of misplaced confidence in supposedly reputable merchandisers and prominent mediums for advertising.

Mr. Harding through apparently authentic sources of information delves into the various phases of fraud in this country, including textiles, foods, drugs, cosmetics, patent medicines, stocks and bonds, real estate, and gadgets of all kinds. The part fraud plays in undermining sound business, and in degrading the various valuable mediums of advertising are shown to be rather alarming.

The book makes no unwarranted effort to frighten the reader, in fact at the end of the book is an appendix of six pages which points out some one hundred or more instances where a recently published book* which became one of the best sellers, was entirely wrong in statement of fact, or conclusions drawn.

One reading the book is stirred by mingled feelings of surprise, amusement, resentment, and a desire to do something about it.—L. A. O.

*100,000,000 Guinea Pigs.

CLASSIFIED

POSITION WANTED—Textile Print Chemist with seven years laboratory and practical experience in printing and dyeing now available. Familiar with all types of printing and dyeing procedures. Lowell Textile Institute training. Excellent references. Write Box No. 850, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.